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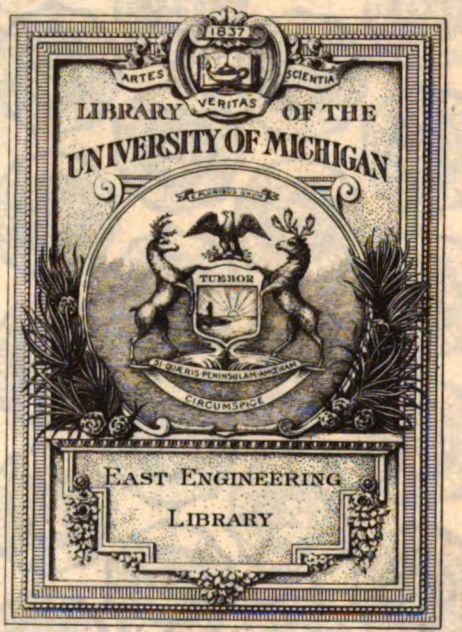


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Mining and Metallurgy, January, 1923, No. 193—Section Two

# MINING AND METALLURGY

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# Mining and Metallurgy

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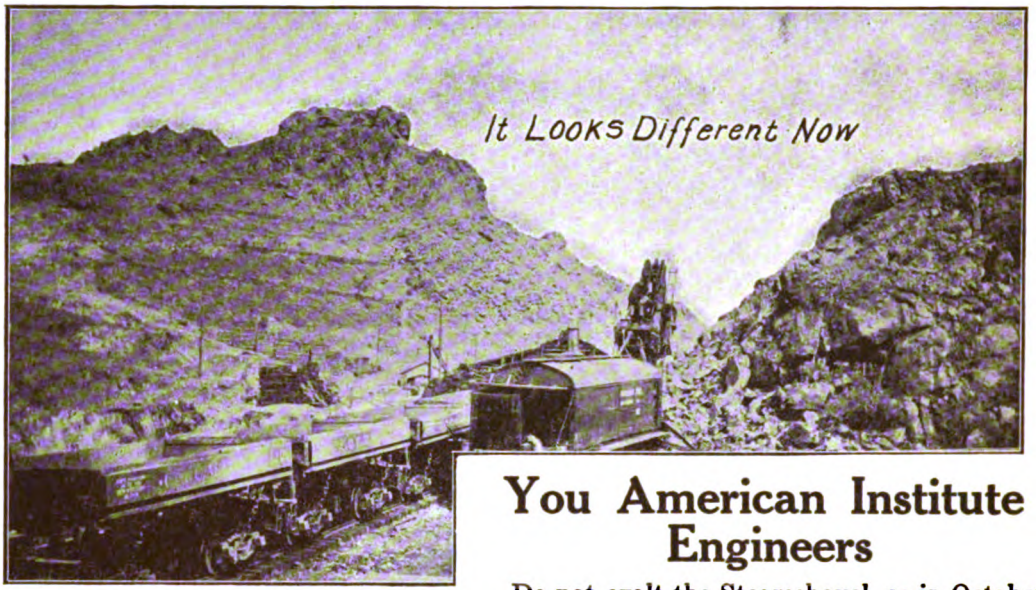


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FERDINAND FOCH
HONORARY MEMBER OF NATIONAL ENGINEERING SOCIETIES

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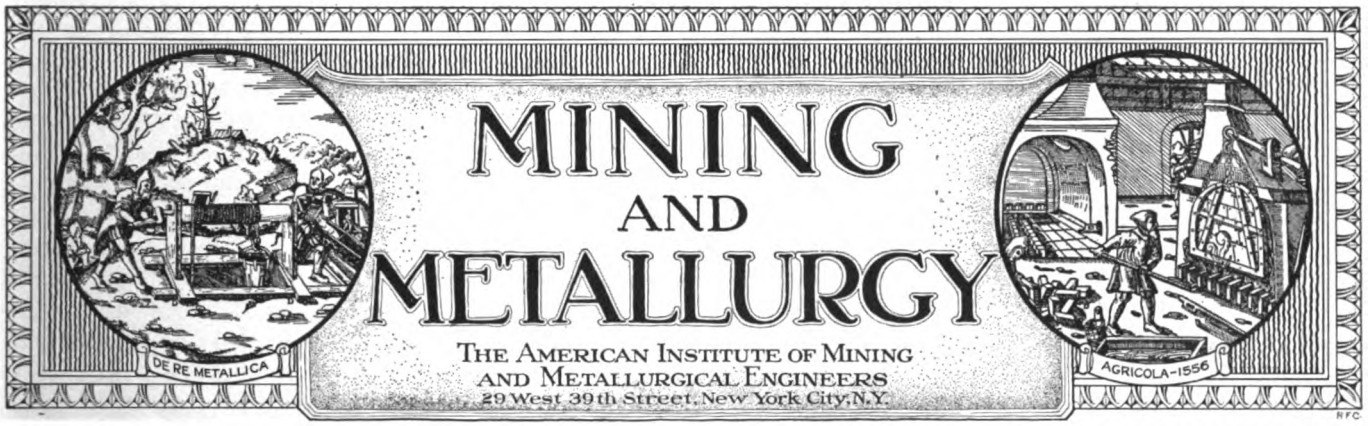


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## EDITORIAL

### Waste in Industry

I THINK that a rather unfortunate thing about the report of the committee of the Federated American Engineering Societies was its title. "Waste" is commonly associated with the ideas of profligacy or carelessness in the use of something that has been produced. If, for example, the manager of this magazine bought paper in sheets of such size that about one-third of the weight had to be sacrificed in trimming down to dimensions, that would be recognized instantly and correctly as waste, and the management would be reprehensible. If, however, the management, without being either profligate or careless, were failing to produce the magazine as economically as might be done by one of greater intelligence and ability, no accusation could be brought against it except that of unintelligence and incompetence. In industry, labor is guilty of waste when it insists that two men be put upon a job that one can easily do. I doubt if management is chargeable with so much actual waste as is implied, though it is true that it is often inefficient, and, moreover, that many of our industries function badly. I conjecture that the committee probably holds just these views, and it is likely that it employed the term "waste" simply as a convenient expression. I grant that it is not easy to find a better one.

It is no part of my thought to discuss the division of responsibility between management and labor, which I do not think can soundly be expressed numerically in such a way as the committee has essayed. I am not going to raise any issue upon this point, for I believe that experience has amply proved that neither labor nor politics, nor both together, can effectively direct industry; and the whole responsibility must be shouldered by those who have the ability to manage, asking of labor only that it will not stand in the way. Let management, therefore, earnestly study the committee's report and try to profit from it. There is much in it that is suggestive and constructive.



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Lest the report be accepted as a gospel upon the evils of management as heretofore exhibited in the United States, let me, however, draw attention to two things about it that have struck me especially. One is the danger that readers of the report may consider that the derelictions of management are measured against a scale of superior intelligence, *i.e.*, against what engineers and experts think ought to be achieved, not what the several industries known how to do. This is not what the committee intended to convey, inasmuch as a careful reading of its report shows that the standard of measurement was the best actual performance in each industry. The other thing that struck me especially is that the industries selected for study and report, *viz.* building, men's clothing manufacturing, shoe manufacturing, printing, metal manufacturing, and textile manufacturing, comprise several that are notoriously badly organized. Some of the great industries like metal mining, metallurgy, and chemical manufacturing were not included in the survey. I conjecture that if such affairs as those of the U. S. Steel Corporation and the Anaconda Copper Mining Co. had come within the scope of the committee's examination, it would have had a different story to tell. Organization in the only practicable way is, however, one of the things whereof many persons complain. The theoretical, or I might better say the hypothetical, organization of industry has not worked at all, as Lenine and his collaborators in Russia have recently testified.

It seems to me that the committee has been somewhat querulous and has fallen short of a broad economic view. For this reason I hesitate to accept some of its conclusions, or if I do so it is with reserve. One of the greatest faults that it finds with our industries is the irregular employment that they afford, and their overbuilding and overmanning. These evils—for evils they are indeed—are closely associated with business cycles, a subject that I discussed last month. The undulations may be tempered by greater transparency in industry—I am using this expression in the economic sense—but heretofore the management of industry has not known how to accomplish this. It cannot fairly be blamed for what it has not known how to do. It is working now actively in that direction and we hope that something useful will be achieved, but we do not know yet that it will be, or can be. I have no doubt that the committee had a full understanding of these limitations, and I am drawing attention to this subject more in the way of warning against misinterpretation of the committee than of criticizing it.

Overbuilding is, in a way, a consequence of obscurity. There comes a sharp upturn in industry, increased profits and the temptation to provide new plant for the purpose of participating in the profits. Owing to imperfect knowledge of conditions, everything is always exaggerated and overdone. With the inevitable turn of the tide downward the industry is left with an expanded administration and an enlarged personnel, with the consequences that the latter can not obtain full annual employment and the cost per unit of production is enhanced by that and other factors. The bituminous coal-mining industry is the classic example of such a deplorable situation.

The committee found similar conditions prevailing in boot and shoe manufacturing, in the making of men's clothing and in other industries. Recent investigations of my own lead me to believe that not only is the committee right as to this, but also that in general American manufacturing industry is greatly overbuilt at the present time. This is largely a consequence of the war. It is partly a consequence of natural overenthusiasm on the part of the American business man. But it is partly a result of labor unionism. I am not sure whether the last has heretofore been brought out.

Labor is characteristically immobile, *i.e.*, it tends to cling to its habitat. For example, by chance the manufacture of shoes was started at Lynn, and of copper goods at Waterbury early in the history of this country. The respective industries continued in those places for no particular reason other than the development of populations skilled in the art, who grew up there and were indisposed to move away. In the course of time, however, the exactions of labor unions became so onerous that some shoe manufacturers were forced away from Lynn and Haverhill, and gradually the industry became so spread out that it attained the chronic condition of being overbuilt. In the same way printing was extended from the cities to the near-by country towns. During the last ten years the manufacture of women's garments, employing about 50,000 workers in the vicinity of New York, has been diverted from large, organized factories to a myriad of small shops dispersed over a large area, urban and suburban. In the consideration of efficiency of industry, attention ought to be given to major questions like these.

It is but recently that there has been begun the study of industrial and economic conditions by minds capable of seeing things broadly and understandingly. The professors of economics who have ventured into this field see things commonly in only an academic way, while other students who are unacademic are apt to be unscientific. There have been, for example, pretentious studies of the eight-hour day, but among them there has not been anything adequate. What scale of living the American worker can obtain at the present time by a universal eight-hour day is absolutely unknown, although of course we know what a part of the workers can achieve at the expense of the others, especially when they are assisted by the mechanicalization of industry resulting from the brains of engineers. Reflections of this nature give rise to little thoughts in my mind that perhaps the committee in minutely examining individual trees, and even their leaves, did not always get a true perspective of the whole forest.

W. R. Ingalls.

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# Marshal Foch Made Honorary Member of Engineering Societies

MARSHAL Foch has been made an honorary member of the four national American societies of civil, mining and metallurgical, mechanical, and electrical engineers. The governing bodies of these societies, aggregating 45,000 members, conferred this signal honor in expression of the appreciation of American engineers for the unmatched services of this master of engineering principles.

At Engineering Societies Building, in New York City, on Tuesday afternoon, Dec. 13, the presidents of the four societies presented one beautifully engrossed certificate of honorary membership in the four societies. The auditorium was filled so that not even standing room was left, more than a half hour before the ceremonies began, and the main entrance on the street had to be closed. J. Vipond Davies, president of the United Engineering Society, made the opening address. Col. William Barclay Parsons, who was commander of the first engineer regiment to go abroad, addressed Marshal Foch in French. Colonel Parsons said:

The art of engineering was defined a long time ago as "the art of directing the great sources of power in nature for the use and convenience of man." No better definition can be found today. Of all the sources of power in nature, the greatest, the most valuable, and at the same time the most difficult to direct, is the energy of man himself. He who can direct human energy and turn it to the service of mankind is a great engineer.

You, Marshal, have directed a greater mass of human energy than any other man has ever done. And you have successfully directed this mass for the highest uses of mankind, in that you by its aid have preserved for him one of the most precious of human possessions—liberty—liberty not only for your own illustrious country, but for all the nations of the world.

The four national engineering societies of the United States now desire to make record of their appreciation of this fact and to convey to you an expression of their most profound admiration for the great leader of men by conferring on you honorary membership in all the societies, the highest honor in their gift and one hitherto never conferred on a single individual.

Four thousand members of these societies were enrolled in the armed service of the United States, the greater part of whom had the glorious distinction to serve the common cause in France under your orders. They heard the voice and they saw the hand of the master as he led them through battle to victory. Now we desire that you will still continue to lead us, but in peace, by permitting us to inscribe your name at the head of our roll of honor, where it will be, as your deeds have been, an example to us to do better work, and where it will remain forever a noble inspiration for all future generations.

Marshal, in the name of those members of the societies who served under your orders and particularly in the name of those who fell on the field of honor in France, I salute you.

He was followed by George S. Webster, president of the American Society of Civil Engineers, who presented to Marshal Foch the certificate conferring upon him honorary membership in the four national societies.

Marshal Foch responded in French and again, as when he made his first appearance, was received with the greatest applause and enthusiasm. He said:

It was due largely to engineering and the engineering industry that the war was brought to a successful conclusion. To the engineering profession also we are indebted for many great lessons which will be vital to mankind in the future.

The armies could not have done a great deal without the effort of the engineer. Success was made possible to a great extent by the industry of the people at home, but when it became a question of decision, when the decisive moments arrived, the engineer stood out as an essential factor in complete triumph.

What would have become of the armies without the technical training, without the professional knowledge which you have exercised for the Allies and which enabled us to lead our armies in the field, to feed them, to protect them and to facilitate their advance quickly and decisively?

It is for these reasons that I am pleased to meet you here today, to receive from you so splendid a welcome and to express my gratitude and the gratitude of France, as well as the recognition of my countrymen for the tremendous sacrifices made by you and the men of your calling.

I am grateful to you for including me in your ranks as a member of the four great engineering societies of the United States. Believe me, this honor which you have conferred upon me I indeed appreciate and I shall cherish this event with the happiest memories.

Charles P. Perin then made a short address in French and presented each of the presidents of the four national societies with replicas of medals struck in commemoration of the Marshal's visit to the United States.

The arrangements of this elaborate function were in the hands of Charles F. Rand and, inasmuch as every detail had been foreseen, the arrangements worked perfectly and the function was an inspiring success.

Marshal Foch presented each society with an autographed photograph of himself (like the frontispiece of this number) and, in addition, an autographed French edition of his "Principles of War" for the Engineering Societies Library.

The Marshal's visit to this country as guest of the American Legion has revived and enhanced our appreciation of his incomparable service and of the victories of the soldiers of the united nations typified by the American Legion.

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American Society of Civil Engineers
American Institute of Mining and Metallurgical Engineers
American Society of Mechanical Engineers
American Institute of Electrical Engineers

This Certifies that

FERDINAND FOCH

Maréchal de France

The World's Greatest Soldier

in recognition of his unparalleled service to mankind has been elected by the unanimous vote of our several Boards of Direction an

Honorary Member

of each of these four National Engineering Societies.

In Witness Whereof this Certificate is signed by the President and Secretary of each Society and delivered in the City of New York the thirteenth day of December, nineteen hundred and twenty-one.

American Society of Civil Engineers
President
Acting Secretary

American Institute of Mining and Metallurgical Engineers
President
Secretary

American Society of Mechanical Engineers
President
Secretary

American Institute of Electrical Engineers
President
Secretary

CERTIFICATE PRESENTED TO MARSHAL FOCH BY THE FOUR NATIONAL ENGINEERING SOCIETIES

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The fundamentals of engineering achievement are coöperation and coördination. It was the ability of Foch to supplement his military genius with the effective coöperation of the commanders of the armies of five nations and the coördination of their operations that won the great victory.

Late in March, 1918, with the British Fifth Army shattered and the situation of the Allies decidedly precarious, Haig telegraphed to Lloyd George to come to France and informed him that in his opinion a single commandership should be established. Lord Milner was sent. Poincaré and Clemenceau were informed. These three met, with their principal generals, at Doullens on March 25, 1918; with Clemenceau, was Foch. After a half-hour's private conference between Milner and the British generals, all assembled. Clemenceau reviewed the military situation very briefly, questioning the commanders, and then presented Foch, giving a short statement of his fitness. Milner asked for a moment in private with Clemenceau; they retired to a corner of the room. Without preamble, Milner said: "The British generals accept the commandership of Foch." Clemenceau responded: "Is that from your Government?" "The British Government has guaranteed that it will ratify whatever we decide. Are you in accord?" "We agree. Now we must have a suitable form of announcement. We will see Foch." After a half-minute's reflection, Foch quickly wrote: "By decision of the Governments of Great Britain and France, General Foch is charged with coördinating on the west front the operations of the French and British armies whose commanders-in-chief, Marshal Haig and General Petain, will be given all the directions required for the establishment of such coördination."

Seven months and a half later, Foch was chief figure in another historic conference. Near Rethondes, in the forest of Compiegne, he received the German plenipotentiaries. The interviews occurred in the Marshal's train, which, built for the Liége Exposition, has become historic. A witness has described the first interview. Foch arose majestically and made a slight salute to the plenipotentiaries.

"Gentlemen," he said, "introduce yourselves. You have before you Generalissimo Foch; here is my chief of staff. Now show your credentials. . . . Good, your papers are in order. What do you wish?"

"We have come to discuss the armistice."

"I do not understand. Discuss? You mean to receive our armistice conditions."

As Erzberger attempted to engage in a discussion, he continued: "It is not a time for discussions. It is a question of taking or leaving. Otherwise the war will continue. You have forty-eight hours to make your reply. Gentlemen, you may withdraw."

The outcome was the armistice, signed on Nov. 11, 1918.

The possibility of continuing on to Berlin was discussed repeatedly before the interview with the German plenipotentiaries, but Marshal Foch deemed it wiser to see if the Germans would accept the conditions of the Allies. "These conditions are just as hard" he said, "as if we were in Berlin. The opportunity has arrived. It must be seized. Merely to obtain—perhaps—a satisfaction which would bring no further real advantage, the Marshal does not wish to risk so many more human lives, nor to exact too many sacrifices from troops which have suffered. Yes, we might go further, we might impose upon Germany a new Sedan, but it would be necessary to sacrifice thousands of men, and that I ought not to do."

Chronologically arranged, the events in Marshal Foch's career to the beginning of the war are as follows:

| | |
|---|---|
| 1871 | Student, École Polytechnique |
| 1873 | Student, École d'Application d'artillerie |
| 1874 | Lieutenant assigned 24th Regiment artillery at Tarbes |
| .... | 2 years student at École de cavalerie |
| 1878 | Captain, 10th Regiment artillery at Reunes |
| .... | In "Section Technique" of Ministry of War |
| 1885 | Chosen for École de Guerre |
| .... | On staff of division |
| 1891 | Major attached General Staff |
| .... | Commander of 3rd battery horse artillery |
| 1894 | Back to General Staff |
| 1895 (Oct. 31) | Associate professor of military history, strategy and applied tactics at École Supérieure de guerre, or Staff College. |
| 1896 | Lieutenant Colonel. Full professor. |
| .... | Lectures at École de guerre issued in two books: "The Conduct of War" "The Principles of War" |
| 1900 | Went to 29th Regiment artillery |
| 1903 | Colonel, 35th Artillery at Vannes |
| 1905 | Chief of Staff, 5th Army Corps at Orleans |
| 1907 | Brigadier General, General Staff |
| 1907 | Director, École de guerre |
| 1909 | Gave course in Higher Strategy Originated School for Marshals |
| 1911 | General of 13th Division |
| 1912 | Command 8th Army Corps |
| 1913 | Command 20th Corps at Nancy at outbreak of war |

By official decree Aug. 6, 1918, Foch was made a Marshal of France. This military rank, abolished at the overthrow of the Empire, had been revived by a decree, Dec. 24, 1916. His baton bears the name of Ferdinand Foch, engraved in gold letters, with the inscription: "Terror belli decus pacis."

Ferdinand Foch studied engineering in École Polytechnique and École d'Application d'artillerie. He served on the technical section of the Ministry of War early in life, and in later years was a full professor in École de Guerre.

No man can attain eminence as a commander of modern armies without mastery of the principles and practices of several branches of engineering. Ferdinand Foch was not only trained in the applications of engineering to military purposes, but also taught some of these branches in France's notable war schools and practiced them in the field.

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## Building-trade Union Practices in New York

SOME of the practices among the labor unions in the building trade in New York that were brought out in evidence before the Lockwood Committee in December, 1921, are interesting.

Christian G. Norman, chairman of the board of governors of the Building Trades Employers Association, stated that for anybody to secure a license to run an electric hoister it is necessary first to pass an examination as a steam engineer at police headquarters.

The practices of the Plasterers' Union are particularly ingenious. It is required that models be destroyed upon completion of any job, although they are purchased from the union by the contractor. The president of the union explains that "it would throw our modelers out of work if these models were passed around too freely."

During the construction of the Ambassador Hotel, the union caused part of a ceiling to be torn down because "certain union regulations had not been fulfilled."

Whenever more than three men are required for a plastering job, a fourth must go with them to act as foreman.

The vice-president of this union, which comprises about 25,000 members, said, "The meanest thing I know of is for a workman to commence work before 9 o'clock and to keep on after the whistle blows at five. That is meaner than picking a man's pocket."

The Electrical Workers' Union has derived a huge income by restricting its membership to 3800 (about one-fourth of the electricians in the city) and issuing working permits at $2.50 per week to non-union workers.

Reverting to the Plasterers' Union, one day recently 21 men were fined $5 each for an offence known in the trade as "browning on green scratch coat." The fines in such cases go into the treasury of the union, but the owner or builder who had the bad job wished on him has to pay for having it rectified.

"When a job is botched and the men fined on account of it, wouldn't it be a good idea for the union to pay for it out of the fines?" asked the investigator.

"Well, I never thought of that," replied the president of the union.

The requirement that every three-man job should have a foreman was not apparently a fixture, for in one case a man who was building an apartment house was fined $75 for refusing to employ a foreman on a job that took only two men.

It was brought out with the aid of records of the union that a squad of plasterers on a certain job was held until 5.10 p.m. one day, while the employer was occupied in paying them off. For this offence the employer was required to pay $2.38 per man, *viz.*, one-fourth day wage for the 10-minute delay. Another employer was fined $1000 for paying his men for over time on the hour and half-hour bases instead of the quarter-day, which latter the union prescribes as the minimum.

If anybody wants to have a room redecorated and there are cracks in the plastering, the painter can not fill the cracks, no matter how small they are. A plasterer must come for that purpose.

"Soldiering" on the job has been a regular principle, as was testified by numerous witnesses. There were, however, ways of curing this. One contractor testified that in building an apartment house 22 plasterers finished only 11 rooms in three days. It was highly desirable to complete the job by the end of the week. There remained 2½ days and 48 rooms to do. The contractor bet the foreman $100 that it could not be done. It was done.

It is not only the employers that the leaders of the union have soaked. The members of the union themselves have been mulcted from time to time. The minutes of the executive committee of the Plasterers' Union showed that it was customary to fine plasterers for working a few moments over time and to discipline foremen for helping out men when they were in difficulties in their work. One foreman was expelled from the union for a year for showing an inexperienced plasterer how to handle his tools more effectively. It was brought out that there is a rule in the union preventing any man from "rushing on the job," *i.e.*, working faster than his colleagues. The opinion was expressed by one union leader that "a laborer who rushes a job is guilty of a crime almost equal to murder."

Nine workmen of Italian, German and Hebrew extraction were fined $19 each for working on St. Patrick's Day, 1920. St. Patrick's Day is not a legal holiday in New York.

A certain member of the union was fined $115 by the executive committee for making out an affidavit in a suit for an injunction against the union.

These are not excerpts from a humorous book, but are from the records of hearings by a legislative committee. In the building trade of New York City about 100,000 to 120,000 men are employed.

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## American Petroleum Institute Elections

THE directors of the American Petroleum Institute have just elected the following officers: Thomas A. O'Donnell, president; R. D. Benson, Henry L. Doherty, and J. W. Van Dyke, vice-presidents; H. F. Sinclair, treasurer; R. L. Welch, general secretary and counsel; W. R. Boyd, Jr., assistant secretary and counsel; C. C. Smith, assistant treasurer.

The following new directors of the Institute have been elected: B. B. Brooks, Casper, Wyo.; J. D. Collett, Fort Worth, Tex.; George N. Moore, Chicago, Ill.; E. T. Wilson, Denver, Colo.; W. M. Welch, Tulsa, Okla.; Sheldon Clark, Chicago, Ill.; T. J. Gay, Little Rock, Ark.; E. C. Lufkin, and E. B. Reeser, New York.

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# Caving Systems of Mining

By J. PARKE CHANNING
Vice President, Miami Copper Company

THE caving system of mining is that method of removing the ore from an underground body in which the top is first attacked and mined out and the capping, or roof, as the case may be, is allowed to fall in or "cave" and fill the space formerly occupied by the mined ore. It is applicable, generally, to large orebodies where the ore is relatively soft. We may say, within moderate limits, that when ore is removed the surrounding ground either caves in or remains open. For example, in mines like the Lake Superior amygdaloid copper mines, when the lode is removed there is left a void which remains open for many years; on the contrary, mining a Lake Superior soft hematite ore, however carefully it may be done, always produces a caving of the surrounding rocks. We may say, with propriety, therefore, that the caving system is applicable to that type of ore deposit in which the surrounding rock readily caves.

Another factor which governs the use of the caving system is the value of the ore itself. Admittedly, any form of caving will not extract 100 per cent. of the ore, and in the case of a very rich orebody it is often desirable to get out every pound of the ore with as little dilution as possible. Under these conditions, some other method of mining, such as that by square sets and filling, is indicated and should be followed. We may say, however, that, looking at it broadly, in the United States the caving system of mining is generally used for the removal of soft hematite and for the so-called "porphyry" coppers. In both cases this method is used where open-pit mining is not possible.

## Three Caving Methods

Caving systems of mining may be divided into three general classes; top slicing, sub-drift caving, and block caving. In top slicing, successive layers, usually about 10 ft. in thickness, are taken, beginning at the top of the ore and so on successively down. In sub-drift caving, the ore is taken in thicker slices; say, for example, from 14 ft. to 22 ft. thick, of which the lower 8 ft. is taken out with timber and the upper 6 to 14 ft. is pulled down and drawn on the retreat. The block caving system is one in which the slices are anywhere from 35 to 100 ft. in thickness and in which the ore, after suitably breaking up, is drawn out through a multiplicity of chutes in a series of drifts driven at the bottom of the slice.

In attacking a new orebody whose outline has been sufficiently determined, in the two cases first mentioned, it is frequently the practice to establish a level near the top of the orebody, but below the deepest irregularity of the capping, and mine out the first slice by square sets. This is done with a two-fold purpose, not only to give enough reach to the capping so that it may break and settle down, but also to establish a flat surface from which the slicing or sub-drift caving below may proceed in a regular manner. Great care must be taken in this preliminary operation, so that a cave may not occur with a sudden rush of air, with its resultant damage. This method is not always used, but has been found desirable and necessary in several of the Lake Superior hematite mines.

## Caving Introduced from Lancashire

It is well to consider first the sub-drift caving system, as this was the first method introduced into the United States. In 1881 or 1882, George W. Wallace was in charge of the Cleveland Hematite mine near Ishpeming, Mich. The orebody was a soft hematite which was being mined with square sets. There came to the mine two miners from Dalton-in-Furness, Lancashire, England, who were expert in what was known as the caving method and who explained it to Captain Wallace. He realized its good points and introduced it into the Cleveland Hematite, or old Nelson mine, as it was frequently called. I am not able to say whether the method used there was sub-drift caving or top slicing, but I am inclined to think that it was sub-drift caving. Captain Wallace wrote a description of the method about 1910, but it was never published and the manuscript was lost when he moved to the west.

The first time I saw the sub-drift caving system was at the Brotherton mine at Wakefield, Gogebic County, Mich., in 1886. John Pengilly was in charge of the mine, having been sent there by D. H. Bacon, who was at that time general manager of the Cleveland Iron Mining Co., and under whom Captain Wallace was mining captain at the Cleveland Hematite. The Brotherton hematite was a rather soft ore and the orebody was of somewhat irregular shape, varying in width from 20 to 40 ft. and dipping probably at an average angle of 45°, though at times the irregular foot wall was steep and at other times nearly vertical. The main levels were about 60 ft. apart and each lift was mined out in four successive layers of 15 ft. each. Raises were put up 50 ft. apart along the strike, and these were connected with sub-drifts, leaving in each case a 6- to 7-ft. back. Therefore, when a level

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was opened, these successive layers of 15 ft. were opened, with drifts along their bottom.

Stoping or mining was started at the far end of the top lift, gradually drawing back toward the shaft crosscut, timber being used for the bottom 8 ft. and the top 7 ft. being drawn or caved as retreating was continued toward the shaft. A description of this may be found in an article written by myself.[1]

It is interesting to note that at about the same time Guy R. Johnson adopted a very similar system at the mines of the Longdale Iron Co. in Virginia.[2] Probably very soon after this a similar method was used in mining the orebodies in Lowmoor, Va., as described by W. S. Hungerford.[3]

I think the first time that we on Lake Superior realized that this work was being done in Virginia was when the late Guy R. Johnson, Sr., visited the Menominee Range in 1887–88, to examine the Chapin mine, and told us what he was doing. It shows how frequently the same problem is solved in a similar manner in different parts of the world. Since that time the sub-drift caving method has been in continuous use throughout the United States in various classes of mines and is today a good standard method. The thickness of the slice removed depends entirely on circumstances. If reduced to the mere height of the regular drifts, the method is the top-slice system, and when the thickness becomes 35 or 40 ft. or over, the method merges into the block caving system.

### Factor of Success of Sub-drift Caving

The success of the sub-drift system depends very largely on the building up of a "mat" of crushed timber between the ore and the broken capping or "gob." Even at the best this "mat" is never perfect and when the ore from above the timbers of the extraction drift and below the "mat" is drawn out, waste material invariably trickles down through it and dilutes the ore. At times rushes of the "gob" come and some of the ore is lost. In hematite mining, where very frequently the "gob" is a low-grade iron ore, this dilution does not amount to much, but often in the mining of "porphyry" ores, where the ore may run 2 per cent. in copper and the "gob" only 0.2 per cent., this dilution and loss is of importance. It is evident, however, that the thicker the slice in the sub-drift method, the less ore has to be breasted out or actually mined, and more ore is cheaply won by caving the upper part. Only the results of careful experiments and calculations can show the proper mean. There are many modifications of the sub-drift caving system and these are well described in numerous articles in the Transactions of the A. I. M. E.

In the top-slice system, haulage levels are put at any convenient distance apart, usually 100 ft. vertically. The haulage drifts themselves are sufficiently numerous and are so spaced that raises from them can reach the top of the orebody at points not more than 50 ft. apart from one another, the object being to avoid too much tramming to these raises in the slices. The usual thickness of one of these top slices is 10 ft., this being the distance from the bottom of the post to the top of the lagging, though sometimes the height may be only 8 ft. and at others it may be as high as 12 feet.

### Advantages and Disadvantages of Top Slicing

In taking out this top slice, various plans are used, dependent on the area of the orebody. Frequently a system similar to the long-wall retreating method of coal mining is used and a long face, the full width of one dimension of the orebody, is kept constantly open. The ore is removed in a drift along this face, perhaps two sets wide, then the further drift timber is blasted in and a new one driven back of the one left opened. This method, however, is often difficult to maintain, and a successful modification of it has been described by E. G. Dean.[4] In this case the slice is divided into 250-ft. squares with a central supply raise to each square and the usual number of raises down which the ore is dumped.

In any method of this kind, hand-tramming is necessary, to transfer the ore from the place where it is broken to the raise; this is done either by direct shoveling, by wheel barrows, or by small cars of one-ton capacity. Endless belts and scrapers have been tried, but without success. Great care must be taken, in this method of mining, to insure ventilation, as open drifts are not as numerous as in the sub-drift method. Good ventilation can be maintained, however, by a careful system of plenum and suction drifts which are not interconnected.

An interesting modification of the top-slicing method is that of making the floor of the slice inclined. This obviates to a large extent the necessity for shoveling and hand-tramming. Its use in the Coronado mine in Arizona is described by W. G. Scott,[5] but it is well to note that in the Coronado mine the orebody is relatively long and narrow and it is questionable whether this method can be successfully employed in a large orebody where it might be necessary to divide the slicing area into 250-ft. squares.

The advantage of the top-slicing system is that one has a practical control over the mining of the ore. It is in reality all breast stoped with, of course, an increase in cost as compared with the sub-drift system, but with the advantage that nearly all the ore is removed and the admixture of waste is reduced to a minimum. In case of any unexpected caving, in which a block of ore is temporarily lost, its position can be

[1] *Mineral Industry* (1894), 3.
[2] *Trans.* (1891) **20**, 96.
[3] *Trans.* (1888–9) **17**, 103.
[4] *Trans.* (1916) **55**, 240.
[5] *Trans.* (1918) **59**, 303.

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accurately determined and a large part of it may be taken out on the next slice, either by square-setting or by drawing. In this connection, it will be desirable for the student to read the paper on Methods of Iron Mining in Northern Minnesota, by F. W. Denton.[6] On page 383 he refers to the Genoa mine, which, in the year 1897, mined about 300,000 tons by the top-slice method at a total cost of 41 cents a ton including all underground and surface expense, taxes, etc. This, I believe, is the record for underground mining on Lake Superior. I have not any unit costs on the Mesabi Range for that time but I do know that the cost of timber and planking was extremely low because at that time the pine in the district was being cut and marketed.

It is interesting to note the comparison Mr. Denton gives between top slicing and sub-drift caving, where he says, "Ore by such a method (sub-drifting) is, of course, much more cheaply broken than that which is sliced or broken out, but it is a question of both gain and loss."

### Development of Block Caving System

Block caving has resulted from a gradual development of some extremely crude methods of taking out pillars left from a room-and-pillar system of mining and from modifications of the sub-drift system. In the early days on the Gogebic Range, it was customary to mine the ore with square sets made of round timber, the rule being a three-set room and a three-set pillar. This made the room considerably wider than the pillar, equal to the thickness of one post and two sets of lagging. The room was carried up as far as was safe, perhaps leaving one or two sets between the back of the room and the floor of the level above. Care was not always taken that rooms should be under rooms and pillars under pillars. For a rough guess, probably not over 40 per cent. of the ore was taken out in the rooms and 60 per cent. was left in the form of pillars and floors. Drifts were then driven through the middle of these pillars undercutting the ore and drawing out what would come. Probably not over half of the remaining ore was taken out before the waste came, so that the gross extraction would not exceed 70 per cent.

In other mines, when attempts were made to increase the thickness of the slices in the sub-drift method of mining, similar losses and dilution took place. I think we may say that *successful* block caving systems grew out of the development of the shrinkage-stope method of mining in some of the large orebodies. In some cases, the orebody was divided into sections 50 ft. wide running from one edge of the orebody to the other and a 25-ft. overhand stope was started in each section, the men standing on the broken ore in doing their work, the excess ore being drawn out from chutes. When it came to removing the pillars it was often found that these would not cave of their own volition, or if they did, the pieces were too large and could not be drawn out when the shrinkage ore was drawn. This led to making the thickness of the combined room and pillar less, at times as small as 25 ft., with a 10-ft. shrinkage stope and a 15-ft. pillar, or vice versa. These operated better, and finally it was discovered that it was not necessary to put up these shrinkage stopes at all. All that was necessary was to get in hand-tramming drifts sufficiently close to undercut the ore and let it drop down and then draw it out through a multiplicity of raises. In some cases this undercutting was boldly attempted without having gone through the shrinkage-stope method, and this is particularly exemplified in what is known as the Ohio method, which is described in several places in the A. I. M. E. Transactions and in the *Engineering and Mining Journal*. This Ohio method is particularly noted for its economy of raising, all the raises being approximately at an angle of 45° and running off from each other like the branches of a tree. In the Ohio system the blocks or layers drawn are about 35 ft. in thickness, and at the Ohio mine, which is a particularly low-grade mine, it was an eminently satisfactory method.

### Difficulties of Properly Drawing Caved Ore

As has been pointed out frequently by Henry S. Munroe, for many years professor of mining at the School of Mines, Columbia University, it is not particularly difficult to undercut an orebody and break it up. The great difficulty has always been in controlling the drawing of the ore so as to prevent piping or funneling, and an undue admixture of waste with the ore. A modification of the Ohio method, employed at the Ruth mine of the Nevada Consolidated Copper Co., is clearly explained by Walter S. Larsh.[7] It will be noted, in the drawing on page 300, that the ore is drawn so as to maintain a line of contact between the broken ore and the caved capping, approximating 40°. As he says at the bottom of page 301: "The critical part of the whole system is to draw the ore properly after it has been caved. The expectancy of each raise series is calculated from all available data, such as drill holes, raises or other workings, and charted.

The amount to be drawn from each finger is determined by the stope engineers from the charts and model and is given to the foreman and bosses each shift. The angle of the contact between ore and capping from the raise series completed to those being brought in is maintained between 30° and 40°."

At the Miami Copper mine, in Arizona, after having gone through the experience of narrow shrinkage stopes and pillars, a block-caving system has been developed in which the blocks drawn are 75 ft. high. The main haulage levels are 150 ft. apart, so that the ore above each haulage level is taken out in two layers or blocks.

[6] *Trans.* (1897) **27**, 344.

[7] *Trans.* (1918) **59**, 299.

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From any particular haulage level the top of the ore to be drawn is 175 ft. above the floor of this haulage level. The first hand-tramming level is established 100 ft. above the haulage level, or 75 ft. below the top of the ore. Parallel hand-tramming drifts are then driven, varying from 18 to 25 ft. apart up to the boundary of the ore. Along each hand-tramming drift, are dump chutes 50 ft. apart, which are connected, by a system of vertical and inclined raises, with the drifts in the main haulage level. Along these hand-tramming drifts numerous short raises with chutes are put in and at a somewhat higher level than the hand-tramming level, so-called mining drifts are driven; each mining drift is untimbered and is halfway between the adjoining hand-tramming drifts. After these hand-tramming drifts and mining drifts are put in, holes are drilled in the sides of the mining drifts and those nearer the extremity of the orebody are blasted, thus undercutting the ore and causing it to settle down just above the hand-tramming drifts. The broken ore from the chutes of the hand-tramming drifts is then drawn, under the same supervision as at the Ruth, so as to establish a plane between the capping and the broken ore, which in this case more nearly approximates 60° than the 30° or 40° mentioned for the Ruth. The ore from these raises is trammed back by hand, dumped down the nearest chute, and eventually finds its way down the main haulage level. On the general retreat, before any particular section of the hand-tramming drift is abandoned, the ore immediately on top of it is mined out in a manner similar to that of the so-called "mining drifts;" in this way the ore is practically drawn down to within a short distance above the hand-tramming drifts. If capping comes from any particular chute before the time determined by the engineers, it is known that piping has taken place. This particular chute is then sealed off and the surrounding chutes are drawn, which usually breaks up the pipe. The sealed chute is reopened and the clean ore usually comes after a few cars of waste are removed.

### Advantages of Miami System

The advantage of this system is that with its multiplicity of chutes the drawing of the ore is under complete control and a minimum amount of ore is lost and a minimum amount of dilution takes place. The whole orebody is not drawn back from the boundary but is divided into panels 150 ft. wide, leaving corresponding pillars between, so that each panel as it is drawn back is served by either six or eight hand-tramming drifts. After these panels have been drawn back a certain distance, the intermediate panels are attacked, this method reducing the great pressure that would occur if an attempt were made to draw the whole face at one time.

After the 75-ft. upper block is either mined or retreated sufficiently, the next hand-tramming level 75 ft. below and 25 ft. above the haulage level is opened in a similar manner, although possibly the hand-tramming drifts may be at right angles to those in the upper block. The result is that after the two blocks 75 ft. in height have been drawn the ore is mined down to a point 25 ft. above the main haulage level. In the meantime, the haulage next level below is prepared, but before drawing out the top block on the level below it is desirable to remove the timbers from the upper haulage level so that they may not interfere with the drawing.

In comparing the above method of block caving with straight slicing in copper mining, it may be said that the profit per cubic foot of original orebody will be more than by straight top slicing. The recovery of copper will not be as great per cubic foot of original orebody as that by top slicing, but it is more than made up for by the decreased cost. In comparing a good block caving system with top slicing, I should be inclined to say that for copper ore running 2½ per cent. or over, probably it would be more desirable to use the top-slice method, but that when the ore runs 2 per cent. or under the block caving system would be the better. One advantage of the block caving system is that it requires only half as many miners as the top-slicing method, and, of course, requires very much less timber. If the drawing is conscientiously carried out, the results are entirely satisfactory and the loss by dilution is reduced to a minimum.

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## French Metallurgy and the Great War

A CAREFULLY prepared volume entitled "Nos Usines Métallurgiques dévastées" was issued recently by the *Revue de Métallurgie*. It contains 270 pages, with 300 illustrations, and consists of monographs by French engineers on certain large metallurgical plants that were destroyed by the Germans.

The introduction, which gives various statistics, is by M. Léon Guillet, professor of metallurgy at two of the technical schools in Paris. Abstracts of this introduction, in English, Spanish and Italian, follow the original. M. Guillet says that at the time of the Armistice, 11,500 French works had been destroyed, about 319,269 private dwellings had been razed, and about 313,675 partly demolished. Large numbers of railways, roads, canals, bridges and viaducts also required complete relaying and reconstruction.

The object of the book is to place on record a detailed account of this devastation, and to show that much of it was not made necessary by military requirements, but was systematic and deliberate destruction; also, to tell of the progress already made in the work of reconstruction and to solicit consideration and encouragement for French industrial undertakings.

The book may be obtained from the *Revue de Métallurgie*, 5, Cité Pigalle, Paris (9e), France. The price is 25 francs; post paid (within certain postal limits, presumably), 26 francs.

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# Dusting and Volatilization Losses During Melting of Cyanide Precipitate and Air Refining of Bullion

By GALEN H. CLEVENGER, FRED S. MULOCK and GEORGE W. HARRIS

United States Smelting, Refining & Mining Co., Boston, Mass.

THE losses of gold and silver occurring during the conversion of the precipitate, resulting from the cyanide process, into bullion may occur in two ways: first, there may be mechanical losses during the handling of the precipitate up to the time that it is charged into the melting furnace; and second, there may be losses after the precipitate reaches the melting furnace.

Much of the loss during the handling of the precipitate can be eliminated, and in fact, in modern plants this loss is known to be very small; particularly since preliminary acid treatment of the precipitate with the attendant extra operations has been abandoned in all but certain plants where gold predominates and this extra step is still deemed necessary.

The losses in the melting furnace are from dusting and volatilization; losses in the furnace bottom and linings; floor sweepings; and slag and matte. The gold and silver in the products which do not go out of the flue are readily recoverable by standard methods, and while there may be considerable gold and silver tied up at times, the ultimate loss with careful work should be small.

The losses resulting from volatilization and dusting in connection with the melting of the silver slime from copper refineries have been determined by standard methods, and the possible recovery definitely established through the installation and operation of electrostatic precipitation units. This subject has not been thoroughly investigated in connection with the melting of cyanide precipitate; at least, there are no published accounts of such tests. Experiments have been made in the past to determine melting losses by weighing and assaying the precipitate, but this method gives results which are uncertain on account of the difficulty of accurately sampling and assaying cyanide precipitate. Attempts to ascertain these losses by bubbling a measured sample of the gas through cyanide solution or other absorbent have likewise failed to give dependable results.

The tests herein described were made on the melting furnaces of the Compania de Real del Monte y Pachuca, in order to determine the approximate dusting and volatilization losses during the melting of the precipitate and the volatilization loss during air refining of the resulting Doré bullion.

Zinc-dust precipitation is employed at the Loreto and Guerrero mills of the company. The Loreto precipitate averages 75 to 78 per cent. silver and gold and the Guerrero precipitate 80 to 85 per cent. silver and gold. The melting furnaces are at the Loreto mill and the Guerrero precipitate is taken there in special locked steel containers, by motor truck. The precipitate from each mill is melted separately and the byproducts, so far as possible, are segregated. The precipitate as charged to the furnaces contains 30 to 35 per cent. moisture.

The melting equipment consists of two oil-fired reverberatory furnaces with firebrick bottoms and of conventional design. We have designated them throughout this article as the "small furnace," which has a hearth area of 25 sq. ft., and the "large furnace," which has a hearth area of 49 sq. ft. Each furnace is equipped with two oil burners which are fired with Mexican crude oil residuum.

The regular procedure in melting the precipitate is to preheat the furnace; then a charge of precipitate, roughly mixed with the minimum amount of flux, consisting of borax glass and finely ground bottle glass, is shoveled by hand from shallow charge cars through the work door at the burner end of the furnace. After the first charge has melted, additional charges are added until the desired amount of bullion has collected on the hearth. The furnace is then tapped and the bullion cast directly into molds carried on a special casting machine.

In cases where the bullion was air refined, the desired number of charges were melted and the slag was tapped from the top of the bullion, the last of it being skimmed with a rabble and pulled through the work door. After removal of the slag, air refining proceeded. It has not been the practice heretofore to air refine, since there was no advantage in doing this when outside refineries did the final refining, but now that the company is to have its own electrolytic refinery, it has become a matter of considerable importance to ascer-

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tain to what extent this cyanide bullion is amenable to air refining. It is generally recognized by refiners that it is desirable to eliminate base metals so far as possible by furnace refining prior to electrolytic refining. The tests of which an account is herein given were made, therefore, not only to determine dusting and volatilization losses but also to determine the extent to which this cyanide bullion could be air-refined.

The low-pressure air employed in the earlier experiments was supplied by a small Buffalo Forge motor-driven fan, while in the later experiments a small Roots blower having a delivery opening of 3½-in. diameter was used. The low-pressure air was blown over the surface of the bath from a flattened nozzle inserted through an opening in the back of the furnace and directed towards the work door. The resulting molten oxides were drawn off by cutting down the breast at the bottom of the work door. This operation resembles cupellation as carried on in the English type of cupelling furnace. The high-pressure air from the mill compressors, in those tests in which it was used, was introduced through a length of ½-in. gas pipe inserted through the work door and immersed in the bath of molten metal. This pipe was kept in constant motion so as to reach all parts of the bath. This operation resembles the practice of the copper refiners in eliminating base metals from the Doré bullion resulting from the melting of the slime from the electrolytic copper-refining tanks, except that they generally use both sodium nitrate and soda as well as air to eliminate selenium and tellurium.

Slag and bullion samples were taken every half hour, the first being taken at the beginning of the refining period. The fineness of the final bullion was determined by the bullion essays on the bars shipped from each melt.

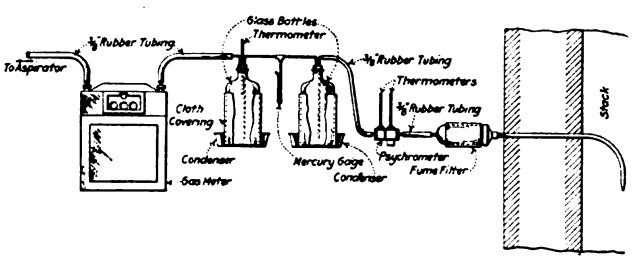


FIG. 1.—GENERAL ARRANGEMENT OF APPARATUS.

The volatilization losses were estimated from the data secured by filtering a measured volume of the flue gases through paper extraction thimbles, and ascertaining the total volume of the flue gases by Pitot tube readings. The general arrangement of the apparatus used is shown in Fig. 1 and details of the fume filter and psychrometer in Figs. 2 and 3.

The fume filter was originally constructed according to the drawings given in an article by Touzalin.[1] In this design the plug 1 is tapered and fits into a similar taper in the shell 2. The filter thimble is slipped over the plug and placed in the shell, the whole being made tight with the nut 3. This form of filter was found unsatisfactory for two reasons. Unless the nut 3 is tightened excessively so that the filter paper is highly compressed, air is drawn into the apparatus through the filter paper between the plug and shell; it is also obvious that a uniform diameter and thickness of thimble is necessary with the Brady type of filter. The dimensions of the thimbles now on the market

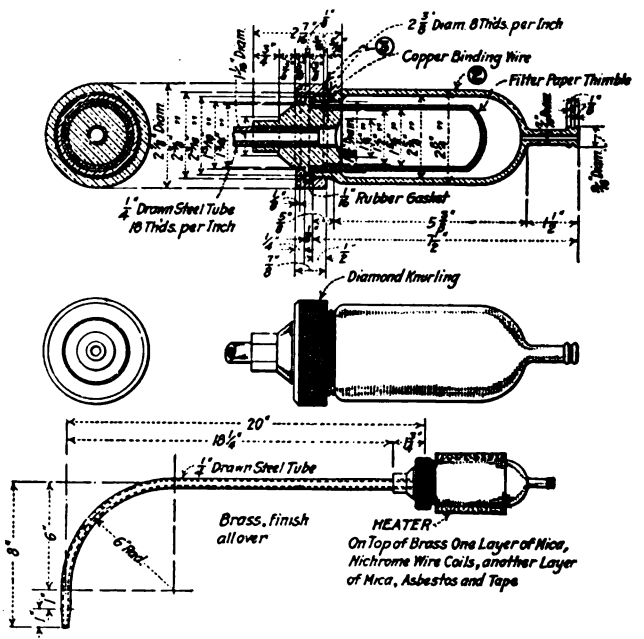


FIG. 2.—DETAIL OF FUME FILTER.

vary considerably. After encountering these difficulties, the form of filter shown in Fig. 2 was adopted. The plug in this has no taper and the thimble is fastened to it by a copper wire. The rubber gasket between the nut and shell gives an airtight joint without the use of wrenches and no difficulty is experienced with the ordinary variations in thimble dimensions.

The glass bottle condensers shown in the general arrangement are necessary because the flue gases carry considerable water vapor. This is especially true immediately after the charging of the wet precipitate. The gas as measured by the meter is saturated at the pressure and temperature obtaining, the excess water collecting in the condensers, where it is measured and its volume at stack conditions calculated. The high water-vapor content of the gas makes it necessary to heat the thimble at times in order to prevent condensation of water upon it.

The volume of the stack gases was calculated from Pitot-tube readings made with a standard Pitot tube manufactured by the American Blower Co. and an Ellison differential draft gage. Exploration tests were made upon the stack to determine the ratio of the average to the maximum Pitot-tube reading, all readings during the actual tests being taken at the point of

[1] L. A. Touzalin: The New Brady Gas Filter. *Jnl. Ind. & Eng. Chem.* (May, 1919) **2**, 312–3.

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maximum velocity. The precaution was taken in every case to maintain the average velocity in the sampling tube the same as the velocity in the stack at the point of sampling.

The temperature of the flue gases was determined by a base-metal thermocouple used in conjunction with a Leeds & Northrup potentiometer-type indicating pyrometer.

Gas analyses were made from time to time, employing the well-known Orsat apparatus. These data were necessary for the accurate calculation of the total volume of the flue gas.

In the series of tests made from March 3 to 6, each thimble was used until the suction pressure increased to about 5 in. of mercury, when it was replaced by a fresh thimble. In the remainder of the tests, the thimbles were changed and the water in the condensers measured at the beginning of each period of charging the precipitate.

The tests from May 3 to 6 were made while the large furnace was in operation, while all those in which air refining was done were made in the small furnace. The stack capacity was too small for the large furnace, therefore the combustion was imperfect and considerable soot and carbon monoxide were present in the stack gases. This stack, which is a relic of patio-process days, is to be replaced by a new flue system of ample proportions. The small furnace is much nearer to the stack and therefore, because of better draft, combustion is nearly perfect. On account of

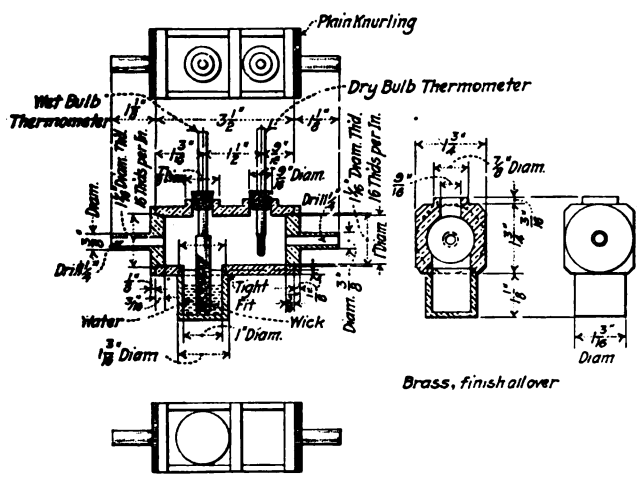


FIG. 3.—DETAIL OF PSYCHROMETER.

less cooling surface, the stack gases from the small furnace are at a much higher temperature than those from the large furnace and at times this temperature was sufficiently high to cause clogging at the tip of the sampling tube, due to a slight sintering of the fume. When this occurred a sharp increase in the suction resulted and the tip was immediately cleaned.

A summary of the volatilization and dust-loss determinations is given in Table 1. It will be observed that there is a considerable variation between the results of the different tests. This is to be expected, as there can be no rigid control of furnace operation and certain factors—for example, dusting—may vary considerably from charge to charge. It is therefore difficult, if not impossible, to deduce definite laws governing these losses; however, certain general conclusions which are of value may be drawn from the results. It should be noted that the melting period in this experimental work was in some cases longer than in the regular practice, and therefore the percentage losses in these cases are correspondingly greater. At times a small amount of fume escaped through the work door on account of poor draft.

The losses are surprisingly small when it is considered that the precipitate is melted in reverberatory furnaces without briquetting. The average loss of silver is 0.1074 per cent., and of gold is 0.02805 per cent., for the Loreto precipitate during melting. The average loss of silver is 0.0625 per cent., and of gold is 0.0150 per cent., for the Guerrero precipitate during melting.

The average loss of silver is 0.0497 per cent., and of gold is 0.0133 per cent., during air refining of Loreto bullion. The average loss of silver is 0.0156 per cent., and of gold is 0.00387 per cent., during air refining of Guerrero bullion. These are average losses for the whole period of air refining which in every case was prolonged more than necessary in order to make sure that the end had been reached. The loss of both silver and gold is considerably greater during the melting of the precipitate and the air refining of the bullion with Loreto precipitate than with Guerrero precipitate. The ratio of silver loss of Loreto to Guerrero for the whole of the precipitate melting period is 1.72 to 1 and the ratio of gold loss is 1.81 to 1. Taking the average hourly losses, the ratio for silver is 1.37 to 1 and for gold is 1.54 to 1.

The ratio of silver loss of Loreto to Guerrero for the whole air-refining period is 3.2 to 1 and the ratio of gold loss is 3.44 to 1. Taking the average hourly losses, the ratio for silver is 4.03 to 1 and for gold is 4.22 to 1.

It will be observed that this difference is sufficiently consistent to preclude its being due to experimental error or variation of conditions in the furnace. We are unable to give a definite reason for this phenomenon but it is of significance that the Guerrero precipitate contains more lead and copper than does the Loreto precipitate. We also have had other evdience which indicates that certain base bullions show less loss by volatilization during melting and holding a charge of molten metal in the furnace than does refined silver. The effect of lead upon the amount of silver carried over in the distillation of the zinc crusts from the Parkes process has been investigated by Dewey,[2] who says that "lead protects the silver from the drag of the volatilizing zinc."

The losses during the melting of the precipitate

[2] F. P. Dewey: Silver Volatilization in Smelting. *Eng. & Min. Jnl.* (July 19, 1919) **103**, 87.

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appear to be independent of the hearth area of the furnace. This also appears to be the case during air refining of the bullion, but our data are not sufficiently complete to justify more than the statement that the indications are in this direction. It was found that the volatilization losses during remelting of the bullion are relatively high per unit of time as compared to those when melting precipitate, but as the time required is short the total percentage loss is small. None of the bullion is remelted in regular practice.

to 1. The ratio of silver to gold in the fume both during melting of the precipitate and air refining of the bullion shows a very wide variation ranging from 300 to 2400.

These experiments demonstrate that there would be no difficulty in eliminating by simple air refining without the use of fluxes practically all the base metals with the exception of a portion of the copper. This gives a Doré bullion that is well suited to electrolytic refining.

TABLE 1.—*Summary of Volatilization and Dust-loss Determinations*

| Day | Final Bullion Assay, Parts per 1000 | | | Precious Metal Content of Final Bullion, Kilograms | | Approximate Loss in Stack, Kilograms | | Approximate Percentage Loss in Stack | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | For Total Period of Furnace Operation, Per Cent. | | Per Hour of Furnace Operation, Per Cent. | | |
| | Dore | Ag | Au | Ag | Au | Ag | Au | Ag | Au | Ag | Au | |
| **Melting Loreto Precipitate** | | | | | | | | | | | | |
| 9/2/20 | | | | About 3000 | | | | 0.0642 | 0.0204 | 0.00284 | 0.000900 | Large furnace operating |
| 3/2 to 3/3/21 | 979.399 | 973.616 | 5.783 | 2436.688 | 14.473 | 1.727 | 0.003082 | 0.0709 | 0.0214 | 0.00346 | 0.00107 | Large furnace operating |
| 3/3 to 3/4/21 | 982.339 | 976.544 | 5.795 | 1690.556 | 11.219 | 2.909 | 0.004804 | 0.1537 | 0.0431 | 0.00522 | 0.00145 | Large furnace operating |
| 3/21 to 3/23/21 | 980.18 | 974.26 | 5.92 | 2589.570 | 16.086 | 3.987 | 0.005542 | 0.1541 | 0.0344 | 0.00486 | 0.00109 | Small furnace operating |
| 3/25 to 3/27/21 | 975.714 | 969.877 | 5.837 | 3116.239 | 18.757 | 2.933 | 0.003846 | 0.0942 | 0.0205 | 0.00335 | 0.000733 | Small furnace operating |
| Averages | | | | | | | | 0.1074 | 0.0280 | 0.00395 | 0.00105 | |
| **Melting Guerrero Precipitate** | | | | | | | | | | | | |
| 9/4/20 | | | | About 3380 | | 1.347 | 0.002430 | 0.0433 | 0.0125 | 0.00179 | 0.00517 | Large furnace operating |
| 3/4 to 3/5/21 | 933.040 | 927.380 | 5.660 | 1790.896 | 10.930 | 0.808 | 0.001425 | 0.0452 | 0.0131 | 0.00331 | 0.000763 | Large furnace operating |
| 3/20 to 3/21/21 | 935.14 | 929.60 | 5.54 | 2112.228 | 12.825 | 1.629 | 0.002478 | 0.0774 | 0.0193 | 0.00396 | 0.000988 | Small furnace operating |
| 3/23 to 3/25/21 | 937.76 | 932.14 | 5.62 | 3377.164 | 20.843 | 2.843 | 0.003152 | 0.0843 | 0.0151 | 0.00247 | 0.000442 | Small furnace operating |
| Averages | | | | | | | | 0.0625 | 0.0150 | 0.00288 | 0.000680 | |
| **Refining Loreto Bullion** | | | | | | | | | | | | |
| 3/23/21 | 991.772 | 985.650 | 6.122 | 2589.570 | 16.086 | 1.238 | 0.062137 | 0.0497 | 0.0133 | 0.00706 | 0.00204 | Surface and subsurface blowing. Initial bullion assay—Ag; 974.26; Au, 5.92 |
| **Refining Guerrero Bullion** | | | | | | | | | | | | |
| 3/21/21 | 986.930 | 980.974 | 5.956 | 2112.226 | 12.825 | 0.393 | 0.0002990 | 0.0186 | 0.00233 | 0.00176 | 0.000222 | Surface blowing initial bullion assay Ag, 929.60; Au, 5.54 |
| 3/25/21 | 985.693 | 979.648 | 6.045 | 3377.164 | 20.843 | 0.425 | 0.001129 | 0.0126 | 0.00541 | 0.00174 | 0.000746 | Surface and subsurface blowing. Initia bullion assay, Ag, 932.14; Au, 5.62 |
| Averages | | | | | | | | 0.0156 | 0.00387 | 0.00175 | 0.000483 | |
| **Remelting Loreto Bullion (Not Refined)** | | | | | | | | | | | | |
| 3/6/21 | 982.893 | 977.074 | 5.819 | 1829.445 | 10.895 | 0.240 | 0.000285 | 0.0131 | 0.00262 | 0.00827 | 0.001655 | Large furnace operating |

NOTE: All percentage losses are based upon the metal contents of the shipping bars actually produced.

The two tests upon air refining of Guerrero bullion indicate that the silver losses per unit of time during this period are not greatly influenced by the method of applying the air. The high-pressure air, however, eliminates the bases more rapidly so that maximum refining possible is reached more rapidly than with the low-pressure air, with, therefore, a smaller total loss. The gold losses appear to be distinctly greater with the high-pressure air than with the low-pressure air.

The ratio of silver to gold in both the Loreto and Guerrero precipitate will average approximately 165

The slag and bullion assays and analyses for a typical air-refining test on Guerrero bullion are given in Table 2. It will be noted that there is a rapid elimination of base metals during the first three hours—or up to about 985 fine—after which the elimination is slow. This is typical of the Guerrero bullion when using either low- or high-pressure air, except that, when using high-pressure air, the time required to reach this point is only about one-half that required with low-pressure air. The slag volume, as might be expected, decreases rapidly with the increase of bullion fineness.

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The composition of the Loreto precipitate is such that the greater part of the base metals combine with the slag during melting and are thereby eliminated, giving a bullion of 970 to 980 total fineness silver and gold before air refining. The total fineness can be increased to over 990 by air refining.

TABLE 2.—*Typical Air-refining Test on Guerrero Bullion*

| Sample | Assays, Kilograms per Metric ton | | Analyses, Per Cent. | | | | |
|---|---|---|---|---|---|---|---|
| | Ag | Au | Cu | Pb | Zn | $Fe_2O_3$ $Al_2O_3$ | Insoluble |
| **Slags** | | | | | | | |
| Slag from melting precipitate | 1.201 | 0.0055 | | | | | |
| Skimmings after: | | | | | | | |
| 1st hour air | | | 2.12 | 57.0 | 12.4 | 17.4 | 5.4 |
| 2nd hour air | | | 3.01 | 55.1 | 7.6 | 17.8 | 13.9 |
| 3rd hour air | | | 6.23 | 52.9 | 5.8 | 19.6 | 15.2 |
| 4th hour air | | | 8.66 | 47.8 | 4.2 | 23.2 | 15.4 |
| 5th hour air | | | 10.50 | 43.1 | 3.8 | 26.0 | 16.2 |
| 6th hour air | | | 12.20 | 37.5 | 2.6 | 25.2 | 17.8 |
| 7th hour air | | | 9.40 | 32.8 | 2.4 | 26.4 | 21.5 |
| 8th hour air | | | 8.90 | 29.0 | 2.0 | 25.8 | 24.6 |
| 9th hour air | | | 9.3 | 26.9 | 2.0 | 25.0 | 26.3 |
| 10th hour air | 125.336 | 0.091 | 9.3 | 22.3 | 2.0 | 20.4 | 27.6 |

**Test Bars**

| Sample | Dore, Parts per 1000 | Ag, Parts per 1000 | Au, Parts Per 1000 |
|---|---|---|---|
| At start of blowing | 935.14 | 929.60 | 5.54 |
| After blowing: | | | |
| 0.5 hr | 951.82 | | |
| 1.0 hr | 963.10 | | |
| 1.5 hr | 970.92 | | |
| 2.0 hr | 979.98 | | |
| 2.5 hr | 984.76 | | |
| 3.0 hr | 986.52 | | |
| 3.5 hr | 985.66 | | |
| 4.0 hr | 986.16 | | |
| 4.5 hr | 986.96 | | |
| 5.0 hr | 989.68 | | |
| 5.5 hr | 987.62 | | |
| 6.0 hr | 987.94 | | |
| 6.5 hr | 988.60 | | |
| 7.0 hr | 988.32 | | |
| 7.5 hr | 988.82 | | |
| 8.0 hr | 990.28 | | |
| 8.5 hr | 987.68 | | |
| 9.0 hr | 989.28 | 983.42 | 5.86 |
| Average of shipping bars | | 980.974 | 5.956 |

The percentage of silver and gold in the Guerrero precipitate is higher than in the Loreto but the proportion of lead and copper is also higher, so that melting of the precipitate produces bullion of a total fineness of but 933 to 938. The total fineness can be increased to 980 to 985 by air refining.

We are indebted to the management of Compania de Real del Monte y Pachuca for permission to publish these results and to George S. Embury, general superintendent of mills, for helpful coöperation in making the tests.

## Eliminating Waste in Estimating

A REPORT on quantity surveying and payment for estimating, with recommendations to owners and investors, architects, engineers and contractors, has been approved and adopted by the American Institute of Architects, American Engineering Council of the Federated American Engineering Societies, and the Associated General Contractors of America.

The purpose of this report is to acquaint prospective owners and others financially interested in building and other construction projects with the wasteful duplication and consequent expense involved in the preparation of estimates of quantities under the systems now generally in vogue. The recommended procedure of quantity surveying is intended to eliminate the present wasteful and uneconomical methods by concentrating the function of determining and compiling the quantities and list of work involved in one agency for each project, this quantity survey to be submitted to all bidders with the plans and specifications. Specific recommendations are:

1. *Quantity Surveying.*—Architects, engineers and contractors should jointly use their efforts to have established facilities for making quantity surveys.

2. *Payment for Quantity Surveying.*—The owner should pay for the quantity survey from ¼ per cent. to 1 per cent. of the cost of the project for commercial and public work and not more than twice as much for residence work, whether the project is constructed or not.

3. *Cost of the Project.*—The cost of the project may be defined as the accepted bid, or in cases where no bid is accepted, the bid of the lowest responsible bidder as determined by the architect or engineer. However, in cases where alternate bids are required, the additional payments for the quantity survey shall be based upon the additional quantities surveyed, as approved by the architect or engineer.

4. *Altered Plans.*—Altered plans which involve a change in quantities after the quantity survey has been made justify an addition to the original fee for quantity surveying.

5. *Basis of Contract.*—Owners should have the option of: (*a*) Making the quantity survey a part of the contract; (*b*) permitting the successful bidder, at his own expense, an opportunity to verify the accuracy and completeness of the quantity survey before the contract is signed. If he proves errors to exist in the quantity survey, the bidder shall be permitted to adjust his bid accordingly.

6. *Unit Quantities and Standards.*—The schedule of unit quantities should conform to local customs or methods of measurement and should be so stated on the quantity survey. The eventual adoption of national standards is recommended.

7. *Guarantee.*—The guaranteeing of quantities by a quantity surveyor is not recommended, for it might

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influence the surveyor to protect himself by increasing the quantities. The extra cost of a guarantee would not be warranted.

8. *Existing Methods.*—The cost to owners of preparing bids by existing methods, which make necessary wasteful duplication in estimating quantities by several bidders, is known to be much greater than the cost of preparing bids based on a quantity survey furnished by the owner, and therefore such existing methods are condemned and should be discontinued.

## Steel Ingot Capacity of United States

THE *Iron Age* on Dec. 8, 1921 gives the following figures on the ingot capacities of the various steel companies in the United States:

| | Ingot Capacity, Gross Tons | Per Cent. of Country's Total |
|---|---|---|
| Midvale Steel & Ordnance Co | 2,894,000 | 5.74 |
| Lackawanna Steel Co | 1,840,000 | 3.65 |
| Youngstown Sheet & Tube Co | 1,500,000 | 2.98 |
| Republic Iron & Steel Co | 1,395,000 | 2.77 |
| Inland Steel Co | 1,000,000 | 1.98 |
| Steel & Tube Co. of America | 900,000 | 1.79 |
| Brier Hill Steel Co | 600,000 | 1.19 |
| United States Steel Corporation | 22,700,000 | 45.00 |
| Bethlehem Steel Corporation | 3,217,000 | 6.38 |
| Jones & Laughlin Steel Co | 2,640,000 | 5.24 |
| Colorado Fuel & Iron Co | 1,138,000 | 2.26 |
| Other steel companies | 10,620,000 | 21.02 |
| Total for the country | 50,444,000 | 100.00 |

The Steel Corporation's ingot capacity of 22,700,000 tons is considered to represent roundly 45 per cent. of the country's total ingot capacity. Some estimates would give a somewhat higher figure, but 45 and 55 may fairly be taken to represent the Steel Corporation and the independent percentages, the 50,444,000 tons standing for a practically attainable capacity, as distinguished from a theoretical capacity.

## Preparation and Storage of Mine Timbers

BETTER preparation and storage of mine timbers are advocated by the Bureau of Mines. The durability and strength may be considerably increased and the consumption decreased, and thus mining costs may be reduced.

Preparation may be considered under two heads—peeling and seasoning. Peeled timber weighs 6 to 10 per cent. less than unpeeled green timber. Therefore, peeling at point of shipment effects a considerable saving in cost of freight. In comparatively dry workings, peeling will increase the life of timber appreciably; in wet places, this is not so apparent. In dead timber, the space beneath the bark is an ideal breeding place for wood-destroying insects. Bark also retains moisture and thus promotes fungus growth.

Records of actual tests show that thoroughly seasoned timber may be from 25 to 50 per cent. stronger than green timber of similar varieties. Under some conditions, seasoning increases the durability, but in general seasoning without preservative treatment does not add greatly to the life. Like peeling, seasoning decreases the weight. Experiments by the Forest Products Laboratory, Madison, Wis., have shown that round mine timbers up to 11 in. in diameter air-seasoned 3 mo. lost 15 to 25 per cent. of their original green weight, depending upon the size and variety of the timber. In general, mine timbers may be sufficiently air seasoned for most purposes in 3 to 6 mo., depending upon the weather, locality, and variety of timber. Timber that is to be treated must be seasoned, as the preservative fluid cannot be injected until at least a part of the water which green timber contains is expelled.

Proper storage is essential for proper seasoning, also for preventing checking and initial decay before placing the timbers in service. Timber yards should be well drained and free from vegetation and decaying wood. Timber should be placed on supports at least 12 in. from the ground, and should be so piled that air can circulate freely.

## Associated Scientific and Technical Societies of South Africa

"DURING the year, great strides have been made toward the realization of the scheme for a joint home of the scientific and technical societies" in South Africa, says the *Journal* of the Chemical, Metallurgical & Mining Society of South Africa. "The premises which had recently been acquired at the date of the last Annual Meeting are now known as the Scientific and Technical Club. They have been put into thorough repair and well fitted and furnished throughout, while a restaurant and tea room have been opened for the convenience of members, and it is expected that the club bar will be opened in the beginning of next month. Generous donations to the funds of the associated societies have been received from members of this Society and their friends, and it is hoped that they will also patronize the club on every possible occasion. Now that the ideal of "closer working and joint housing" has so nearly approached achievement, it is incumbent upon every member of each society concerned to do his utmost to make certain of the ultimate success of the scheme. In February last, this Society transferred its offices from the University College Buildings to the club premises."

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# Bituminous Industry Drifting Toward Further Trouble

By EUGENE McAULIFFE
President, Union Colliery Co., St. Louis, Mo.

SINCE 1917, the bituminous coal industry has surged, violently at times, across the nation's social, industrial and economic foreground. Today a silent, yet more active, force is working within the industry, and the movement now taking place, if allowed to continue, will cause serious consequences when coal is again wanted at the rate of 550,000,000 tons annually instead of at the rate of 400,000,000 tons, the apparent requirement for 1921. I refer to the shift of tonnage from the highly unionized fields of Pennsylvania, Ohio, Indiana and Illinois to the non-union fields of Pennsylvania, West Virginia, Alabama and certain western states, and to the so-called union fields in Kentucky and Colorado, on which the union saddle rests lightly. This movement, in the absence of the usual winter transportation shortage, is taking place rapidly and will be accentuated if, as is probable, work is suspended in the union mines on March 31 next. This drift of tonnage has been made possible by the unit wage reductions in the non-union fields and by the modification of the so-called conditions that have been saddled on all mines wherever the United Mine Workers have gained a foothold; these changes permitted the first reduction in mine cost, which made possible the securance of contracts; better running time assisted in making further reductions, and the transfer of tonnage served to increase the unit cost in the field from which it was transferred. This situation not only opposes the highly unionized operation but brings about a transfer of traffic from the roads serving such mines to those that serve in a primary or secondary manner the more favored localities.

The net result is evidenced in (*a*) the migration of union labor to the non-union mines; (*b*) the deterioration and decadence of union properties; (*c*) the necessary curtailment in the purchase of new equipment and in the maintenance of existing equipment and track facilities on the part of the carriers serving the union fields. This, in turn, when business is restored to normal or to the point above normal that invariably follows an adverse swing of the business pendulum, will cause (*d*) a shortage of coal and coal transportation facilities; (*e*) an era of coal speculative debauchery with exorbitant prices and serious deflection in the matter of quality; (*f*) a period of labor unrest followed by demands for increased wage rates supplemented by a marked loss in individual efficiency, with resultant strikes, business unrest, and the pressure of new economic theories.

In 1918, the labor status with respect to relative tonnage produced was approximately as follows: produced in highly organized fields, 62 per cent.; produced in partly organized fields, 21 per cent.; produced in unorganized fields, 17 per cent.

During the strike of November and December, 1919,. the mines that remained at work attained 35 per cento of the nominal production of soft coal, a situation made possible by the migration of union labor to non-union mines and the concentration of the nation's coal transportation facilities on the rails of the carriers serving the non-union fields. The history of the efforts made by the carriers to untangle the car scrambling which took place during this period and which sent the self-clearing battleship type of car into western territory where it could not be readily unloaded, and the western gondola type of car to New England and the seaboard, is yet painfully recalled. This confusion proved a serious factor in the coal car shortage that continued throughout the following year. We are drifting toward a similar situation now, propelled by economic forces rather than by a sudden strike.

## Public and Carriers, Workmen and Operators, Must all be Considered

Any survey that includes merely the men who work in the mines and the operators who employ them, and that ignores the requirements of the public and the ability of the carriers to furnish the required transportation, can not be considered more than a casual one, and cannot be depended upon as a foundation for betterment. Several months ago the imperative necessity for the liquidation of the high wage scales paid in the union fields was suggested, and although it was urged by our national administration the United Mine Workers, through their leaders, replied with a curt refusal. As a result, the whole organization now stands in a fair way to suffer dissolution—a consummation that, however devoutly it may be wished for by many, is of doubtful value to the producer who seeks stability of investment and a fair return.

Many who have had extended experience in the coal industry view with concern the possibility of absolute non-unionism. No doubt such a state would prove a paradise temporarily to many who have suffered the

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ruthless domination of the unions, but the feeling is well established that any such apparent paradisiacal residence would be short lived, and that it would be only a few months until the temptation of temporary heavy market demand and high prices would shift many producers to the purgatorial zone of labor buying on the part of the predatory producer, from the operation of his more conservative neighbor, which would create as many wage scales as there were mines, and from which the descent into the hades of a new, revivified, and perhaps even more radical organization would prove but a short step.

Speaking broadly, the coal industry, however depressed the position it may occupy temporarily, must be kept in a healthful condition, and serious and far-reaching distortions in the scheme of distribution should not be allowed to enter it. No doubt many changes of value could be made in the present market zones, but they should be made with a view to securing the maximum economy in ultimate fuel costs, one of the major items of which is transportation. The conservation of the gross ton miles expended in the transportation of the nation's fuel represents a task as important as that of securing the maximum possible thermal return from the coal consumed, for gross ton miles mean the absorption of fuel as well as human effort.

The temporary shifting of business from nearby fields of production to those more remote, forced by an artificial economic pressure, does not represent a sound foundation on which to build a returning prosperity and there is crying need today for the collection and compilation of accurate and dependable information concerning the coal industry, which will, when made public, point the way toward a cure for some of the ills from which coal habitually suffers, and assist it toward the position that its magnitude and importance should permit it to occupy.

## Cost of Producing Pig Iron

IN AN article on The Manufacture of Pig Iron in the *Griffin Bulletin* of November, published by the Griffin Wheel Co., Chicago, G. S. Evans, superintendent of the cupola division, presents estimates of the cost of making pig iron in the three principal producing centers, based upon materials acquired at current market quotations:

| | Pittsburgh | | Chicago | | Birmingham | |
|---|---|---|---|---|---|---|
| | Tons | Value | Tons | Value | Tons | Value |
| Ore | 1.8 | $12.42 | 1.8 | $10.17 | 2.7 | $4.89 |
| Limestone | 0.4 | 0.48 | 0.4 | 0.48 | 0.4 | 0.40 |
| Coke | 1.0 | 4.50 | 1.0 | 7.00 | 1.6 | 8.00 |
| Mis. supplies and relining | | 0.81 | | 0.81 | | 0.94 |
| Labor | | 1.08 | | 1.08 | | 1.35 |
| Cost per gross ton | | $19.29 | | $19.54 | | $15.58 |

## Specifications for Steel Forgings

AMONG the eleven standards of the American Society for Testing Materials now before the American Engineering Standards Committee for consideration and approval are:

Specifications for Carbon-steel and Alloy-steel Forgings (A18-21).

Specifications for Quenched and Tempered Carbon-steel Axles, Shafts and other Forgings for Locomotives and Cars (A19-21).

Specifications for Carbon-steel Forgings for Locomotives (A20-21).

Specifications for Quenched and Tempered Alloy-steel Axles, Shafts and other Forgings for Locomotives and Cars (A63-21).

Specifications for Carbon-steel Car and Tender Axles (A21-18).

Specifications A18-21 for carbon-steel and alloy-steel forgings are general specifications covering the various classes of carbon-steel and alloy-steel forgings, on which the other specifications have been based with the addition of special requirements to suit the conditions of use. The preparation of these four specifications for forgings dates back to the earliest history of the American Society for Testing Materials. The predecessor of these specifications was the "Standard Specifications for Steel Forgings," which were first proposed in 1900 and adopted in 1901, previous to the organization of the present A. S. T. M., by what was then the American Section of the International Association for Testing Materials. Since 1901, there have been several revisions of the work, notably in 1914 with the coöperation of other technical societies and associations, including the former Master Mechanics Association and the Master Car Builders Association, now the Mechanical Section of the American Railway Association. The work on alloy-steel forgings other than nickel steel was developed, in 1915, as an extension of the previous work.

The specifications for carbon-steel car and tender axles, while not included in the forgings series, were developed in connection with this work. In 1914, the Committee of the American Society for Testing Materials in charge of these specifications entered into a coöperative investigation with the Master Car Builders Assn., which led to a revision of the specifications, in 1917, that harmonized the requirements in the two organizations. The revised specifications, adopted in 1918, have stood without revision since that date.

In submitting these specifications for approval by the American Engineering Standards Committee, the American Society for Testing Materials has presented data listing the companies, etc. that use them in their entirety or as general specifications on which have been based other specifications suited to particular needs. These specifications have been translated by the Department of Commerce into French and Spanish in connection with the development of foreign trade.

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# Revision of the Mining Law

By F. F. SHARPLESS

Secretary of the American Institute of Mining and Metallurgical Engineers

IT IS to be read in Western newspapers that Hon. S. S. Arentz, who introduced H. R. 7736, has repudiated it, that certain mining men in Utah and Nevada say that they will fight it "until hell freezes over." It is to be read in more temperate expressions that "the eminent engineers who drafted the bill exhibited a woeful misunderstanding of Western sentiment and opinion." Furthermore, it is averred that there is no need for revising the mining laws, that we have got along pretty well under the existing laws, etc. Such statements are so surprising in view of the facts of record that it is hard to believe that the opponents of the bill, who make them, are well informed, or that they represent general opinion. It will be useful therefore to review the record of the case.

## Our Good Old Mining Laws

We have indeed got on well in our mining industry, but that has not been by virtue of our good old mining laws. Rather has it been in spite of them. Ever since the Richmond-Eureka case in the '70s there has been litigation arising from them. Early in the '80s the apex law was discarded by common consent in Leadville, and it has been ignored in every district of flat-lying ore deposits ever since. The great mines of the present time are the porphyry copper deposits. At Bingham, Ely, Ray, Chino, Miami, Clifton and Ajo the apex law is simply inapplicable. A law that is inapplicable to the modern conditions of mining may be an old law, but it can not properly be characterized as a "good" law.

For such reasons, and many others of weight, there has been a demand for revision of the mining laws dating back at least three decades. President Roosevelt appointed a commission to advise respecting the question, said commission comprising Dr. James Douglas (chairman), John Hays Hammond, D. M. Barringer, Walter B. Devereux, and William B. Mather. This committee was unanimous on the following points:

(1) That the provisions of the existing law of the apex should be replaced by a law limiting the possession of minerals in depth by both the end and the side lines carried down vertically. (2) That all mineral and coal lands be laid out and located on the present legal subdivisions applied to agricultural lands wherever possible, and where not possible on lines conforming therewith as nearly as may be, and therefore with lines running always true north and south, east and west. (3) That an official Government map of every mining district be preserved in the nearest county recorder's office, and that within six months of the location of the claim it should be surveyed by a Government surveyor and plotted on said map. (4) That the unit of a mining claim be $\frac{1}{16}$ of the agricultural quarter section, which would be about 660 ft. square (*i.e.*, 10 acres).

In 1911, the Mining and Metallurgical Society of America took up the agitation and appointed a committee under the chairmanship of H. V. Winchell to study the subject of revision of the mining laws, and report.

In 1914, Senator Smoot introduced in the Senate a bill providing "for a commission to codify and suggest amendments to the general mining laws," which was reported out of the Committee on Mines and Mining by Senator Walsh, on March 16, 1914.

In 1915, on Dec. 16, following prolonged discussion of the subject within the Mining and Metallurgical Society, a convention of mining men, largely attended, was held in the Auditorium of the Smithsonian Institution in Washington under the auspices of the Mining and Metallurgical Society of America, the American Institute of Mining Engineers and the American Mining Congress, in collaboration with the Idaho State Mining Association, the Montana Society of Engineers, the California Metal Producers' Association, the Spokane Mining Men's Club, the Nevada Mine Operators' Association and the Colorado Scientific Society, with representatives from several Chambers of Commerce and many operating mines.

## The Interest of the Prospector

In the report of this meeting it was stated "there is a class of men as deeply interested as the engineers, if not more so, in securing these changes, *viz.*, the prospectors and small operators, the men who work, but have little time or means for attending such a convention regardless of their interest. These were conspicuous by their absence, but several hundred letters have been received by the secretary from such men, giving their earnest support to the movement and regretting their inability to attend."

The President of the United States showed his interest. The Department of the Interior not only showed interest but arranged in every way possible to facilitate the objects of the meeting. Practically

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all the senators from the public land states and nearly all the representatives from those states were present at one or more sessions of the convention or indicated by letter their desire to further the objects of the meeting.

The Mining and Metallurgical Society of America presented a set of resolutions, based upon the report of its committee appointed in 1911, the recommendations of which had been put before the members of the society by letter ballot and had been adopted, as to the fundamentals, by practically unanimous vote. The resolutions that had been adopted by the society were as follows:

(1) The mining law should be revised not piecemeal, but thoroughly, so as to coördinate and harmonize its various provisions.

(2) A statute of limitations should establish a reasonable term of years beyond which placer patents shall be immune from attack on the ground of fraud.

(3) Full privilege of appeal to some competent court of law should be provided for in all cases of contests between rival claimants, or between a locator and the Government.

(4) Notice of mining locations should be so recorded as to give the fullest possible public notice.

(5) The apex law should be abolished.

(6) Existing titles should be reaffirmed and fully recognized and no effort should be made to create retroactive legislation.

(7) For the purpose of giving the fullest consideration to the needs of every branch of the mining industry and every section of the country, it is desirable that a Government commission be created by act of Congress, whose duty it shall be to investigate by every proper means the questions and interests here referred to, and to make recommendations as a basis for the proposed mining law revision.

Similar resolutions, of the same general thought and purport, were presented by the American Institute of Mining Engineers, the American Mining Congress, the Montana Society of Mining Engineers, the Utah Chapter of the American Mining Congress, the Pioche Commercial Club and the Spokane Mining Men's Club. The secretary of the Mining and Metallurgical Society reported that ten Chambers of Commerce had written letters approving the plans of the convention and had appointed delegates to attend. About 300 letters had been received by him, and more by the chairman of the committee on revision of the mining laws, from prospectors, operators and mining companies, approving the plan of instituting a revision of the mining laws. Fifteen letters had been received favoring the apex law, but objecting to other features in the existing statutes. Only three letters had been received advising that no alterations of the existing laws be made.

### Convention Advices against Piecemeal Revision

The convention ended its work by adopting the resolutions offered by the committee on resolutions, the essence of which was that "the mining law of the United States should be revised, not piecemeal, but thoroughly, so as to coördinate and harmonize its various provisions; and that a Government commission be created by act of Congress for this purpose."

Up to this time the aspirations and efforts had been directed toward the creation of a Government commission by act of Congress. This had unfortunately introduced the questions of expense and objectionable features that are so often associated with Congressional commissions, and Congress evinced an unwillingness to take such a step. The Mining and Metallurgical Society of America, however, retaining the leadership that it had taken, was unwilling to let the matter drop, and throughout 1916 continued its discussion of the subject, at the same time inspiring the Western state and local societies to continue their discussions. The record of these practically fills the volume of proceedings of the Mining and Metallurgical Society of America for 1916. The discussions crystallized in the submission to the members of the society of a list of 33 specific questions as to how the mining law should be revised. The same list was submitted to all of the organizations that participated in the Washington convention. Upon the fundamental principles that the law of the apex should be abolished, that discovery should no longer be requisite as a preliminary to location and that the phraseology and principles of administration of the present laws should otherwise be preserved to the maximum possible, there was practically a unanimous vote in the Mining and Metallurgical Society of America, the Northwest Mining Association, the Nevada Mine Operators' Association, and the California Metal Producers' Association to which the same questions had been submitted in substantially the same way as in the M. M. S. A.

### Appointment of Bureau of Mines Committee

During all these years and in the foregoing ways the subject had been pretty thoroughly thrashed over. It remained for somebody to embody ideas in a specific bill for the purpose desired which would enable discussion to be focused upon provisions in detail. It had been asked that a Congressional commission be created with that object in view, but hope of obtaining such a commission having been abandoned, it was arranged in conference between Van H. Manning, then director of the United States Bureau of Mines, and Doctor Foster, then chairman of the House Committee on Mines and Mining, to create a committee within the Bureau of Mines. Thus, the mining industry got substantially what it had asked. It had applied for a Congressional commission and it obtained a Governmental committee, which amounted to about the same thing. Director Manning invited the coöperation of the council of the Mining and Metallurgical Society of America with respect to the constitution of the committee, and upon its advice he appointed W. R. Ingalls (chairman), Walter Douglas (vice chairman), Hennen Jennings, John Hays Hammond, James R. Finlay, J. Parke Channing, and L. D. Ricketts. H. V. Winchell took

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the place of Mr. Jennings after the death of the latter. The committee served without remuneration and in the capacity of consulting engineers for the United States Bureau of Mines. The Bureau furnished the committee with a secretary.

The committee thus organized owed responsibility to nobody but the Federal Government. It was not bound by any expressions of opinion that had been made, or resolutions that had been passed previously by societies. Its sole duty was to draft a bill providing for revision of the mining laws that would in its judgment provide best for the mining industry and the national welfare. The prolonged discussions that had preceded the entry by the committee upon its work may be considered as corresponding with the hearings that would have been given by a traveling commission, but probably they were far more comprehensive and representative than would have been heard by any traveling commission.

In considering the work of the committee, it is desirable that the history of the movement toward revision of the mining laws be kept in mind. Some of the critics of the bill drafted by the committee appear to have lost sight of this and also of their own previous actions. Thus the Northwest Mining Association recently passed a resolution which is quoted below. Attention is drawn particularly to the action of this association because it has expressed itself in a concise well ordered resolution which contains about all the objections that have been offered; because on almost every point it reverses its action of a few years since; because a large number of its members are members of the Institute, men whose opinions are worthy of serious consideration; and because these members, having expressed themselves strongly for the revision of the mining law, the Institute supported them, only now to find that it supported something that is apparently offensive to them.

### Reversal of Northwest Position

The resolution passed by the association reads as follows:

Whereas a bill to revise, amend and codify the laws of the United States, relating to the location of mining claims on the public domain, is now before the Sixty-seventh Congress and known as H. R. 7736; and

Whereas, the purposes and probable effects of this bill, if enacted, have been carefully studied by competent committees of this Association and have been adversely reported upon; and

Whereas, the existing Federal mining laws are now well and generally under tood, as interpreted by the courts in the last forty-nine years, and have not proved to be sufficiently defective to require drastic revision, now therefore

Be It Resolved: That the Northwest Mining Association, representing mining interests in the states of Montana, Idaho, Washington and Oregon, at a regular meeting in Spokane, Washington, Nov. 19, 1921, does hereby respectfully protest the passage of this bill on the ground that it is not competent to improve present mining conditions but that, on the other hand, it would doubtless prove burdensome and intolerable in several respects and make confusion worse confounded, as shown by the attached analysis which is hereby made a part hereof.

In the attached analysis by Frank A. Ross, chairman of the committee upon whose report the above resolutions were based, objection is made to the requirement in the committee's bill that locations must conform to the public land surveys; that it compels the filing of location notices, proofs of assessment work, etc. in the United States Land Office only; that it provides for the acceptance of cash payment in lieu of assessment work on a claim; and that it permits location without discovery. Furthermore, objection is raised to change from the present method of obtaining mill sites and finally opposition is expressed "to any tampering with the well established extralateral right."

### Committee on Revision an Advisor not an Advocate

It is to be presumed that the committee of the U. S. Bureau of Mines, functioning as a governmental agent, will not enter into any discussions. Its position is, probably, that it has made its report, and given its advice as to what in its judgment is best. If the mining industry does not want to conform to the committee's judgment, Congress will surely not pass any bill in opposition to the popular wish. Nor will the committee press for any such action. The committee is not an advocate, but rather is an advisor. If Congress after hearing objections that have been raised should request the advice of the committee, the latter would no doubt say with respect to some objections that they are of trifling nature and they might cheerfully be allowed to prevail if the people want to have things in a different way. This would be analogous to the position of a physician who has advised a patient to give up smoking, but yielding to the pleading of the patient allows him to continue the habit, telling him that he would be better without it but will not come to any great harm by continuance.

Probably the committee would so view the matter of cardinal locations, or the optional payment of assessments by the alternatives of cash or work. But the Northwest Mining Association challenged the committee in fundamentals, *viz.*, on the subjects of extralateral rights and abolition of discovery as a prerequisite to location. In fact, the Northwest Mining Association deprecates any revision of the mining laws at all. Yet the Northwest Mining Convention held in Spokane, March 20–25, 1916, passed resolutions declaring the existing mining laws to be unsuited to present needs and to have developed various evil and radical defects that sorely retard or wholly impair the development of our mineral resources; and asking that Congress enter upon the subject of revision; which report was signed by Frank A. Ross as chairman. And at a meeting held Oct. 12, 1916, the Northwest Mining Association, with Frank A. Ross as chairman, declared in resolutions that were then adopted that revision of the mining laws should be undertaken; that the new laws should

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authorize mineral locations *without* discovery in any part of the public lands officially classed as mineral; that the abolition of extralateral rights be strongly urged; and that in lieu of the performance of actual assessment work the owner (of a claim) should be permitted to make a cash payment.

In fact, careful reading of the whole set of resolutions adopted by the Northwest Mining Association, Oct. 12, 1916, discloses that the committee of the United States Bureau of Mines incorporated most of its thoughts, and when departures therefrom were made they were undoubtedly to accomplish reconciliation with the thoughts of other bodies of mining men. For in our republican form of government it is obvious that everybody can not have everything in his own way and maintain that he alone is right. The Northwest Mining Association offers no explanation with respect to the discrepancy between its actions on Oct. 12, 1916 and Nov. 19, 1921. Such diametrically opposite views having been expressed, it would appear that the only possible explanations are a complete change of mind, a misunderstanding o the committee's bill, or a captiousness with respect to it. The Northwest Mining Association characterizes the committee's formula for the location of mineral claims without discovery (which five years previously it had approved in principle) as "one of the most vicious pieces of legislation ever proposed for the regulation of land holdings." But it concedes that some *well guarded* provision should be made by which territory lacking visible signs of valuable minerals may be honorably prospected for suspected deposits. Why not, then, instead of merely condemning the committee's formula, suggest something that would be well guarded. Surely, the committee and everybody else would welcome constructive suggestions.

### Present Laws Pitifully Inadequate

Anybody who has read intelligently the committee's report,* which accompanied its bill, can see that the committee in its deliberations thought of a good many things needful in providing for the mining industry of the future that nobody had suggested in the preceding discussions, prolonged and extensive as they were. On this subject, the Northwest Mining Association objects to any change in the present method of obtaining mill sites. The present method which was drafted in the days of the little quartz mill of 50 years ago, permits the acquisition of a pitiful five-acre mill site. There is no provision in the existing mining laws for acquiring the ground necessary for the big plants of the present day, or for the storage of overburden, tailings, etc. Considering such conditions, as the committee has, it seems rather ridiculous merely to say "leave things as they are."

There is another remark that is constantly cropping up to the effect that the existing mining laws are now well and generally understood, as interpreted by the courts, that even if the extralateral features be bad they have done all their harm. This implies that litigation of that kind is ended. If anybody entertains that opinion, let him consult Mr. Winchell, who is an expert in such cases, and ascertain whether in truth litigation has ended, or whether even the end thereof be in sight. To those who think that all difficult cases have been solved, that the complexities of the existing laws have been interpreted by the courts so that everything is now clear, let them also confer with Mr. Winchell, who would welcome advice as to many difficult cases upon which he is engaged.

### Amendments to Present Law Repeatedly Offered

We may well stand aghast if we find it really to be true that the mining industry of the United States after having expressed itself as desiring a revision of the mining laws, and having urged it to the extent of holding meetings and even a general convention to accomplish the purpose, and having had bills leading to that end introduced in Congress by eminent senators and representatives, should now within the space of five years, during which the committee was diligently and patriotically working for the purpose, declare that no revision at all is wanted; that the existing laws are good enough. It would be incomprehensible that the mining industry, speaking truly, should say such a thing as that. Instead of being a case of preserving the old statutes, the fact is that bills amending the existing mining law piecemeal are being introduced all the time. Several bills of that nature have been introduced at the existing session of Congress and have been held back by the committee on mines and mining of the House of Representatives pending the receipt of the committee's bill respecting which the chairman of the committee on mines and mining of the House of Representatives had been kept informed from the beginning. In compliance with pressure from that quarter the committee's bill was given to the congressional committee even before it had been reviewed by the Secretary of the Interior.

Whether the committee has done a good job, or not, is a totally different matter. As to that, opinions may reasonably differ. It is reasonable to ask, however, that before anybody commits himself to an opinion he should give some study to the subject, and not be carried away by some whim, or merely in following some thoughtless or disingenuous leader.

It must be clear to anybody who gives careful study to the committee's work that it has not advanced any whimsical thoughts. Its recommendations are very much in line with those of the commission under the chairmanship of Doctor Douglas, which reported during the Roosevelt administration. It is even more closely in line with the expressions of opinion among the mining

* Printed in full in *Mining and Metallurgy*, October, 1921.

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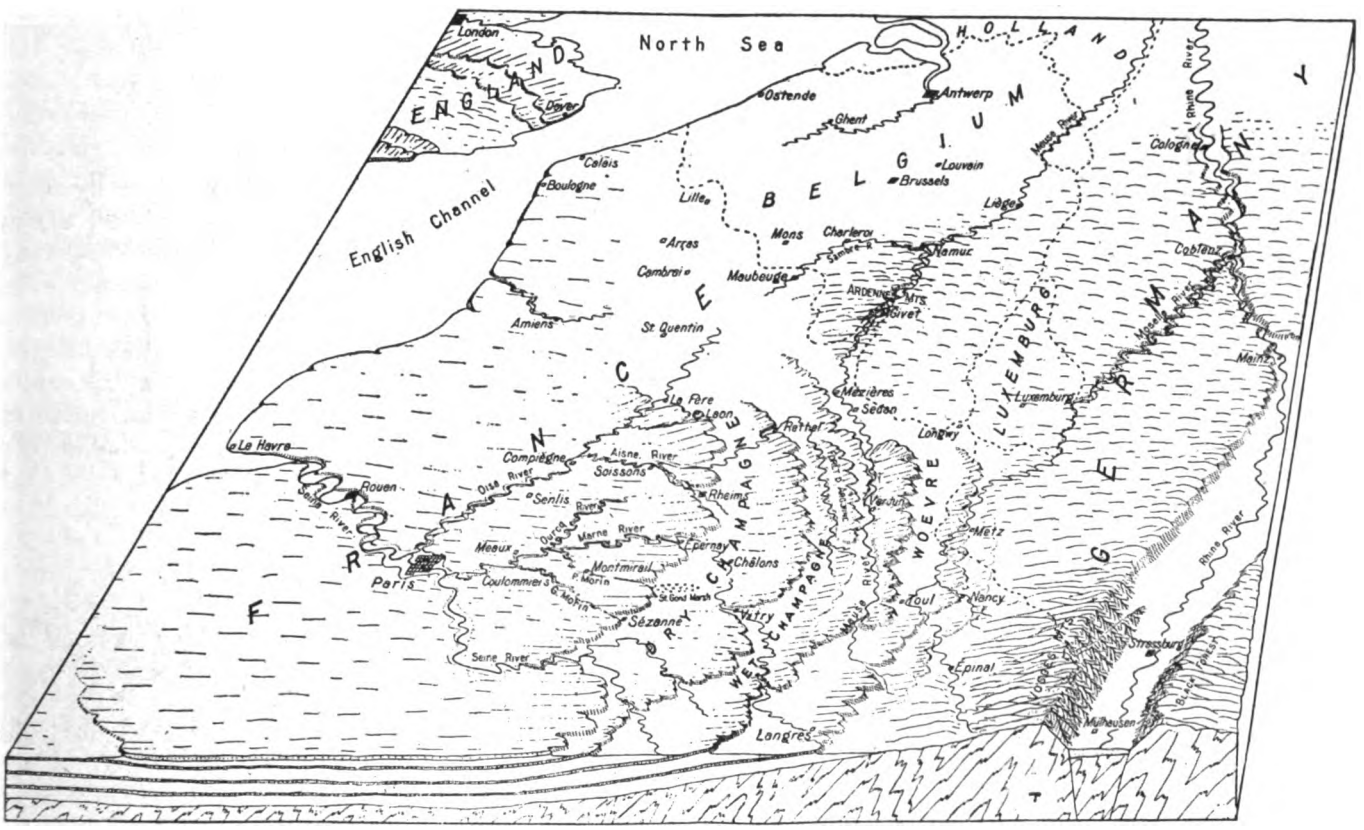
societies, national, state and local, developed through the discussions of 1916. The committee does indeed contemplate making the location of mineral lands more orderly than it is at present, but even in that it does not go very far. As a writer in a recent number of MINING AND METALLURGY remarked, the committee's bill will not make people honest, but it will give them a chance to be honest if they want to be. Could anything more severe be said about the existing laws than that they are so framed that people can not be honest even when they want to be?

Douglas W. Johnson, associate professor of physiography in Columbia University, discussed the effect of geology and topography on the influence of strategy of the world war.

"What is now the country of northern France was in time long past a part of the sea," said Professor Johnson. "When the sea-bottom deposits were upraised to form land, the horizontal layers were unequally elevated. Around the margins the uplift was greatest, thus giving to the region the form of a gigantic saucer or basin. Because Paris today occupies the center of this basin-




DIAGRAMMATIC VIEW OF WESTERN THEATER OF WAR, SHOWING PRINCIPAL PLATEAUS AND PLAINS, MOUNTAINS AND LOWLANDS, CLIFF SCARPS AND RIVER TRENCHES THAT INFLUENCED MILITARY OPERATIONS. UNDERGROUND ROCK STRUCTURE IN FRONT.

Instead of condemning the committee's bill, let those who can, set about improving it. Let them be careful about throwing away the opportunity. There is a general codification of the statutes of the United States in progress. Some day the mining laws, which are scattered through the books and are sadly in need of codification, will be reached. The revision then may be done by hands less friendly to the mining industry than those of the present committee of the Bureau of Mines, which is a part of the industry, and as such both knows the business and is sympathetic.

## Influence of Geology and Topography on Strategy of the World War

AT A MEETING of the New York Post of the Society of American Military Engineers held in Engineering Societies Building on Nov. 1, Major

like structure, it is known to geologists and geographers as 'the Paris Basin.'

"Imagine yourself at Paris, and start on a tour of inspection eastward to the German border. First you traverse the central plateau of the Paris Basin. Here and there, you come suddenly upon the edge of a river valley. Descending the steep slopes of the valley wall, which are often clothed in forests, you reach the flat valley floor several hundred feet below, and make your way over the winding stream. Toiling painfully up the slope you at length come out again upon the flat upland of the plateau surface. Pausing to rest, you look back at the obstacle you have just traversed, and reflect that a number of such obstacles cross the plateau in parallel courses from east to west. You realize that they must prove serious barriers to the advance of armies moving southward or northward; and as you remember that

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two of these obstacles bear the names of the Marne and the Aisne, you have a fuller understanding of two notable chapters in recent military history.

"In surveying the surface features of the western theater of war, we find that the Vosges Mountains, the mountains of western Germany and the Ardennes in Belgium constitute a broad outer zone of comparatively difficult country, within which concentric belts of plateaus with eastfacing scarps defend the most direct approaches to Paris. Only through Belgium into northern France is there a level pathway, free from obstacles, of great breadth most of the way, and provided with every facility for the rapid movement and prolonged sustenance of large armies."

After an illustrated description of the geologic and topographical features of the French theater of war, the specific campaigns were described with especial reference to the topographic features. Professor Johnson is the author of two interesting books, "Topography and Strategy in the War," and "The Battle Fields of France," which take up similarly from a topographical and geological standpoint all campaigns in all of the different strategic operations in the west and in the east.

## Mine-rescue Standardization

ANNOUNCEMENT of the tentative personnel of the various sub-committees of the Mine-rescue Standardization Committee, by George S. Rice, chief mining engineer of the United States Bureau of Mines, and chairman ex-officio of the committee, marks the beginning of the program for definite, practical work toward obtaining international standards in the use of mine-rescue apparatus.

Sub-committee No. 1, on international mine-rescue standards, will act as a liaison committee. Lieut.-Col. J. A. S. Ritson, inspector of mines of Great Britain, has been appointed chairman of this committee. Robert Strachan, senior inspector of mines of British Columbia, is the Canadian representative. J. W. Paul, chief of coal-mine investigations of the United States Bureau of Mines, Pittsburgh, Pa., is secretary. Representatives from Belgium and France will be named later.

Sub-committee No. 2 will deal with rescue-apparatus requirements and tests for permissibility. D. J. Parker, chief of the division of mine-rescue cars and stations of the Bureau of Mines, has been named chairman.

Sub-committee No. 3 will take up the subject of physiological effects in use of mine-rescue apparatus and methods for detection of dangerous gases. Dr. R. R. Sayers, chief surgeon of the Bureau of Mines, is named as chairman. Other members of this committee are Dr. A. F. Knoefel, Terre Haute, Ind., Dr. Yandell Henderson, Yale University, and A. C. Fieldner, superintendent of Pittsburgh Experiment Station, Bureau of Mines.

Sub-committee No. 4 will consider regulations for use of mine-rescue apparatus in coal mines. Robert M. Medill, director of the Department of Mines and Minerals of the State of Illinois, is chairman, and C. A. Herbert, district mining engineer of the Bureau of Mines at Vincennes, Ind., is secretary. E. H. Denny, mine safety engineer of the Bureau of Mines, and Robert Lilly of West Virginia will study regulations for use of apparatus in mines having flat coal beds. Regulations for use of apparatus in pitching coal beds will be taken up by J. J. Forbes, mining engineer of the Bureau of Mines, Birmingham, Ala., and J. J. Corey, Coos Bay, Oregon.

Sub-committee No. 5 will deal with regulations for use of mine-rescue apparatus in metal mines. D. Harrington, mining engineer of the Bureau of Mines, Denver, Colo., will act as chairman. H. J. Rahilly, mining engineer, Anaconda Copper Mining Co., Butte, Mont., will also serve on this committee.

The advisability of standardization of mine-rescue apparatus and methods of use was first suggested by the Hon. William Sloan, Minister of Mines of British Columbia, in a letter to the U. S. Bureau of Mines, dated Sept. 2, 1920, in which he proposed that an international conference be held on the subject. The Bureau of Mines agreed to the desirability of such a conference, with special reference to the methods of use rather than the adoption of any particular apparatus as standard. The conference, at St. Louis, Mo., Sept. 1–3, 1921, was an open one attended by representatives of different governments and departments, representatives from mining companies that carry on training in the use of mine-rescue apparatus, by members of mine-rescue crews and by manufacturers of mine-rescue apparatus. The meetings were presided over by George S. Rice. The following resolution was adopted:

WHEREAS, it is the sense of this conference that it is highly important to advance the art of mine-rescue work by a certain degree of standardization of mine-rescue methods and the use of apparatus and appliances so that improvements may be effected along lines which will guide and assist those engaged or concerned in mine rescue work.

THEREFORE, be it resolved, that a committee be designated by the chairman, at his convenience, that will at some later date or dates as may seem expedient, make a report or reports under the auspices of the Bureau of Mines, which will be made public; and that such committee shall continue its work until such reports have been made or until there shall be a future International Mine-rescue Conference called or held under the auspices of the U. S. Bureau of Mines.

An organization committee met at the Bureau of Mines Experiment Station, Pittsburgh, Pa., Sept. 5–7, and agreed upon the scope of the duties of the various sub-committees.

It is understood that the work of the Mine-rescue Standardization Committee will be carried on largely by correspondence, with occasional meetings as they can be undertaken. All reports are to be submitted to the chairman ex-officio through the secretary, J. W. Paul, United States Bureau of Mines, Pittsburgh, Pa.

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# Personal Notes and Biographies

**Anton Gronningsater** is with the British American Nickel Corpn., Ltd., Ottawa, Ont., Canada.

**Leonard G. Donnelly** is with the Maracaibo Oil Exploration Corpn. at 43 Exchange Place, New York.

**H. P. Parrock** is doing special work with the Draper Corpn. at Hopedale, Mass., and is making his home in the East.

**W. W. Wishon** is living in Kingman, Ariz., where he is consulting engineer for the Katherine Big Four Mines Corpn.

**Joseph W. Revere** has retired from active service in the coal fields and is living at his home in Canton, Mass.

**W. C. Page,** formerly mill foreman for the Walker Mining Co. at Portola, Cal., is sales engineer with the Hardinge Co. in Salt Lake City, Utah.

**Mortimer A. Sears** has re-entered Government service as mineral examiner in the General Land Office, Department of the Interior, Washington, D. C.

**David C. Wray,** recently with the Mineral Point Zinc Co. at Depue, Ill., has been with the American Zinc & Chemical Co., at Langeloth, Pa., since Oct. 15.

**Leslie S. Breckon,** recently mine foreman with the Cerro de Pasco Copper Corpn., in Peru, is now superintendent of the Consolidated Mascot Mines Corpn. at Hailey, Idaho.

**L. Avis Billips** has resigned his position as division engineer of the United States Coal & Coke Co. at Lynch, Ky., and has opened an office in Bluefield, W. Va., for consulting work on coal properties.

**P. B. Lord,** recently mine superintendent at the Morenci Branch of the Phelps Dodge Corpn., is at Minas Tecolotes y Anexas, Santa Barbara, Chih., Mexico, as assistant superintendent of the Santa Barbara Unit, American Smelters Securities Co.

**Stanley P. Rockwell,** recently metallurgist with the Whitney Mfg. Co., has opened an office for consulting work, at 65 Highland St., Hartford, Conn. Mr. Rockwell is the inventor of the Rockwell hardness tester, and will specialize on carburizing and case hardening.

**Henry A. Tobelmann,** who has been with the Calument & Arizona Mining Co. since 1906, has resigned to accept a position in New York. Mr. Tobelmann had much to do with the successful development and operation of the New Cornelia process, which has treated nearly 7,000,000 tons of low-grade copper ore at a good profit.

**T. H. Jenks** is recovering slowly, at his home in Los Angeles, from an illness of two months that began with the bite of a poisonous reptile while Mr. Jenks was on a trip into the interior of the West Coast Section of Mexico from Mazatlan. Blood poisoning set in and infection extended throughout his foot and leg up into the groin. Lack of medical attendance in the beginning made matters worse. The first illness was followed by a severe attack of malarial fever, which has kept him in bed until the present time.

## Joseph Warner Edwards

JOSEPH WARNER EDWARDS, whose death occurred on Nov. 7, 1921, at Denver, Colo., was one of the most able of American mining geologists of the passing generation.

Mr. Edwards was born April 23, 1852, at Philadelphia, Pa., the son of the late Edward Bird Edwards and Lydia Ford Edwards. He attended the public schools from 1858 to 1865 and completed his academic course in Switzerland and Germany from 1865 to 1870. He was an ardent student of rocks from early boyhood, and in 1871 chose geology and mining as his life work. He was a special student of geology at the University of Pennsylvania in 1873–4 and was an aide to Persifor Frazer in the Second Geological Survey of Pennsylvania from 1874 to 1876.

He completed a scientific course at the Royal Saxon Academy of Mines at Freiberg from 1876 to 1879 and at Heidelberg, in 1880–81, took high honors in geology, mineralogy and allied subjects. Then he entered the field of active operations in the three Americas.

He became a member of the American Institute of Mining Engineers in 1876 and was an active member in the early formative days of the Institute; always intensely interested in its proceedings and loyal to its inspirations. He was also a member of the Academy of Natural Sciences of Philadelphia, the Engineers' Club of Phila., the American Association for the Advancement of Science, the Mineralogical Society of America, the Colorado Scientific Society, the National Geographical Society, the Franklin Institute and others. He was always ready to join any group of men in the advancement of scientific research or investigation. His life work was woven into the pioneer mining history of Colorado and the West.

He was a man of high culture, keen analytical mind and gracious personality. His fine attainments as an accomplished and upright scientist, his genial generous

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character and his loyal friendship are a heritage and an influence that will live long in the memory of his many friends and associates. He belongs to that early group of scientists whose aspirations and labors have done so much to formulate and adyance the practice of the profession of mining engineering and to maintain its high ethical standards.

WAYNE DARLINGTON.

## John Elmer Jones

JOHN ELMER JONES was born Dec. 9, 1870, at Summit Hill, Carbon Co., Pa., the son of Thomas D. and Ruth Bynon Jones. He was a student at Mt. Pleasant Military Academy from 1884 to 1888; at Lehigh University from 1888 to 1890; and at Columbia University from 1890 to 1893. He received the degree of mining engineer from Columbia.

He entered the employ of the Mill Creek Coal Co. in 1893, and remained with that company for twenty-eight years. He was assistant superintendent until, in 1917, he succeeded his father in the position of general manager and vice-president. He was on the board of directors of the Vinton Colliery Co., and also of the Hazleton National Bank.

On Feb. 13, 1921, he died very suddenly at his home in Hazleton, Pa., after an illness of only three weeks. His wife, who was Louise Alice Dryfoos before her marriage, died in 1908. One daughter, Ruth, his mother and one sister survive him.

## James S. Cunningham

JAMES S. CUNNINGHAM, well known coal man, died at Saint Francis hospital in Charleston, West Va., on Dec. 12. His death resulted from an accident that occurred as Colonel Cunningham was entering his home by the rear door, after having placed his automobile in the garage. His arms were loaded with Christmas packages and as he stepped upon the top step, his foot slipped and he fell backward, striking his head on the cement walk below. His injuries were found to be so serious that he was taken to the hospital at once for an operation that it was hoped would remove a blood clot that had formed on the brain. His skull was found to be badly fractured on the left side and the operation failed to save his life.

Colonel Cunningham had been a resident of Charleston since 1902. He was personal consulting engineer for E. J. Berwind of New York, the president of the Bengal Coal Co.; general manager of the Kentland Coal and Coke Co. and director and personally interested in a number of other coal companies in West Virginia and eastern Kentucky. He was a director of the Union Trust Co. and of the Y. M. C. A. of Charleston and actively interested in charitable movements. He was rated as one of the foremost experts of the country in coal formation and production.

Colonel Cunningham was of rugged Scotch ancestry and was born in Eckley, Luzerne County, Pa., Sept. 7, 1856. After graduation from Lehigh University in 1879, he was mechanical engineer for the Lehigh and Susquehanna Coal Co., then general manager of the Midvale Ore Co. For the past 32 years he was consulting engineer and geologist for the Berwind interests.

He was a thirty-second degree Mason, a Shriner, life member of the Elks, member of the American Institute of Mining and Metallurgical Engineers, Rotary Club and various local organizations and clubs in the East. He was a member of the Presbyterian church.

His widow and three children survive him. A daughter, Mrs. Worth Clark, resides at Atlantic City, N. J., and two sons, Walter H. and Roy H., live at Huntington. A number of brothers and sisters reside at Allentown and Scranton, Pa.

## Robert L. Ahles

ROBERT LAWRENCE AHLES, president, treasurer and general manager of the Sweet's Steel Co. of Williamsport, Pa., died on Oct. 16, 1921, at Westbury, Long Island. The following quotation is from the Resolutions adopted by the directors of the Sweet's Steel Co. a few days after his death.

> Mr. Ahles came to this city in 1907 and took charge of this company's affairs, and through all its history since that time he has been a dominant and leading figure. Through days of adversity and prosperity he stood unflinchingly in his place. He was always loyal to his company and to his associates. He treated everyone with whom he came in contact with openess, frankness and the utmost fairness. He extended a helping and willing hand to all his employees, from the humblest workman to the highest executive officer. Through good report and evil report he was always the same; steadfast, calm, persevering and onward pressing. We, his associates do record our recognition of his keen intellect, his grasp of general conditions, his business foresight and, above and beyond all, his human kindness and his regard for his fellow man.
>
> We desire to testify to his exceptional interest in the welfare of his employees; his care for their well being; his solicitude for their general welfare; his readiness to assist them in all their personal and private difficulties and to aid them in the struggle of life.

Mr. Ahles was born at Bayside, N. Y., Aug. 14, 1876. His education was gained in military and technical schools. By profession he was a mining engineer and gained practical experience in some of the largest iron and steel concerns in the country.

He was a director of the Trust Company of New Jersey, Hoboken, and of the West Branch National Bank of Williamsport; a member of the Engineers' Union, St. Nicholas, Tennis and Racquet, and other clubs in New York City and of the Ross Club of Williamsport. He was a member of the Sons of the Revolution and of the Cercle Francais, Paris. His technical societies were the American Institute of

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Mining and Metallurgical Engineers, which he joined in 1902, and the American Iron and Steel Institute.

Mr. Ahles served in the navy in the Spanish-American War. He made repeated application for admission to active service after the United States entered the World War, but was refused. He served as a captain in the Red Cross service, in charge of several large hospitals in France and Belgium.

While Mr. Ahles regarded Williamsport as his home, he had a beautiful country estate at Westbury, L. I. He left his wife, Mrs. Helen Kemper Ahles, and one daughter.

## E. A. Miller

ELTON A. MILLER was killed on June 30, 1921, by falling rock. Mr. Miller was mine superintendent for the Saline Coal Co., at Harrisburg, Ill., and was on a tour of inspection through the mine when the accident happened.

"Kelly" Miller, as he was known to his college mates and intimate friends, was one of the most popular men of his college, Missouri School of Mines at Rolla. He was an athlete, and was a four M man in football. He was a member of the Grubstaker Club and Quo Vadis, and was president of his class in his sophomore year. Mr. Miller married Miss Florence Ary, who, with three children, survives him. While in Rolla he joined Rolla Lodge of Masons, and his body was laid to rest in Edwardsville, Ill., according to the ancient rites of Free Masonry, at the request of the Rolla Lodge.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Nov. 15, to Dec. 17, 1921.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1883 | Cunningham, James S. | Dec. 12, 1921 |
| 1911 | Dunstan, Simon P. | Aug. 30, 1920 |
| 1876 | Edwards, J. Warner | Nov. 7, 1921 |
| 1911 | Engel, George W. | March 25, 1920 |
| 1889 | Hancock, Strangman | Oct. 29, 1921 |
| 1920 | Hawkins, William P. | Nov. 23, 1921 |
| 1921 | Wolf, Victor Laurence | Sept. 10, 1921 |
| 1900 | Osgood, Samuel W. | Oct. 4, 1921 |

## Names of Men and of Things

IT IS not often that the name of an individual is added to the world's vocabulary of common nouns but the *New York Times* directs attention to four names that are well known in the field of electricity. The name of the French physicist and mathematician, Ampere, identifies a current of electricity produced by a unit of force which bears the slightly modified name of an Italian electrician (Volta), passing through the resistance of a unit known by the name of a German electrician (Ohm), or which produces a unit of power that bears the name of a Scottish inventor (Watt).

"Despite the fact that a hundred years have passed since Ampere made his great discoveries," says the *Times*, "he is remembered by a republic that is not ungrateful. With all her taxation and privation at home and anxieties abroad, France takes thought of her great citizens of the mind. The whole earth, around which encircling currents run with its daily revolution, as Ampere discovered, has good reason to use an 'ampere hour' with France, in grateful memory of him."

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Soc. Automotive Engrs. | New York, N. Y. | Jan. 11–12 |
| **Amer. Inst. Min. & Met. Engrs.** | **New York, N. Y.** | **Feb. 20–23** |
| Amer. Ceramic Soc. | St. Louis, Mo. | Feb. 27–Mch. 2 |
| Amer. Soc. Mech. Engrs. | Atlanta, Ga. | May 8–11 |
| Foreign Trade Convention | Philadelphia, Pa. | May 10–12 |

## Winter Mining Session in Seattle

THE 26th annual winter mining session of the College of Mines, University of Washington, will be held during the 12 weeks from Jan. 5 to March 22. This session is open to any man who can read and write English. The expense will be limited to a tuition fee of $15, laboratory deposits to cover materials actually used and the cost of the necessary text books. The training consists of lectures with laboratory practice.

## Radium*

FOR many years radium was exclusively produced from the Austrian ores at Joachimsthal; later, it was obtained from pitchblende deposits in Cornwall, and from autunite deposits in Portugal. About nine years ago, officials of the Bureau of Mines found that the carnotite deposits in southwestern Colorado and eastern Utah represented the largest bodies of radium-bearing ore in the world.

At the present time, the United States produces much more radium than all the rest of the world together. From the beginning of the industry in 1913 to January, 1921, approximately 115 gm. of radium element were produced in this country. Probably not more than 40 gm. have been recovered from foreign ores since the discovery of radium by Madame Curie.

*From an article contributed to Engineering Foundation by R. B. Moore, published by permission of the Bureau of Mines.

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# Correspondence and Discussion

## Copper at Retail

IN CONNECTION with the efforts of the copper and zinc producers to increase the use of their metals in domestic consumption, there has been discussion of the prices asked at retail for common articles of copper and brass.

Recently I had occasion to buy 2 doz. ordinary brass screws in the largest hardware shop of a city of 40,000 population. The price was 60 cents for the lot.

"That's a pretty stiff price," I remarked to the salesman.

"Well, you know, the raw materials are mighty dear," he replied, patronizingly, and perhaps with an idea of comforting me.

When I arrived home I weighed the lot on an accurate balance and got a reading of 0.2 lb., from which I computed brass in ordinary wood screws at retail at $3 per lb. The raw materials at recent prices come to about 10 c. per lb. Add a cent for brass-making and then a little for the two simple processes of drawing rods and cutting screws.

I am aware that the retail hardware merchant makes only two turnovers of his stock annually, of his high cost of selling, etc., but with all due allowances for those conditions $3 per lb. for copper screws looks like a discourager of consumption. I should not draw deductions from a solitary and trifling incident, but I think I should like to ascertain if there be any stoppage of the pipes leading to consumption through these agencies.

W. R. INGALLS.

New York, Nov. 20, 1921.

## The Physics of Steel

IN HIS letter of Oct. 6, Mr. John Orth Liebig has opened up again the old question of how near the steel mills should be expected to work to both the chemical requirements and physical tests called for in our standard specifications, without cutting down their output to an unreasonable extent.

He, no doubt, has found some mills that can give him much better and more uniform steel both chemically and physically than others. A careful investigation of the different methods in use at these mills will give him a very fair answer to his question. I would suggest that, after doing this, he give us the results of the investigation at the February meeting of the Institute, as at that time our new discussion on The Physics of Steel will be opened by the presentation of the writer's paper, with several others.

Mr. Liebig has also referred to the heat treatment of alloy steels in rolling and asked some questions regarding same. The writer did not consider these steels at all in his paper, but only refers to the ordinary structural carbon steels.

Alloy steels have come into such general use since our former discussions that they will be given a great deal of attention in our new discussions. The former suggested lines on the discussions of the Physics of Steel will be brought up to date and include the important advances in metallurgy of steel since 1893. Any suggestions that Mr. Liebig can give us for this work on the steels he has referred to will be appreciated.

For convenience of comparison with other steels, it would be well to give the chemical composition of the steels he refers to in addition to the code number of the Society of Automotive Engineers.

For convenience of reference the following extract from Circular No. 3, of 1893, as printed in Volume 24 of the TRANSACTIONS, is here given:

THE PHYSICS OF STEEL

The following lines of discussion are suggested, but are not in any way exclusive.

I. Correspondence between chemical composition and fracture, microstructure and physical properties.

II. Influence of—
- (1) Casting temperature
- (2) Manner and temperature of heating
  - (a) For rolling
  - (b) For annealing
- (3) Work
- (4) Finishing temperature
- (5) Rate and mode for cooling
  - (a) After forging
  - (b) For casting

on
- (a) Fracture.
- (b) Microstructure.
- (c) Physical properties
- (d) Tensile properties
- (e) Residual stress

III. Segregation as affected by—
- (1) Composition
- (2) Casting temperature
- (3) Rate of cooling

IV. Blow-holes and pipes; their volume and position as affected by—
- (1) Composition
- (2) Casting temperature
- (3) Casting pressure
- (4) Rate of cooling
- (5) Special additions
- (6) Forging

V. Hardening: relation between tensile properties and hardness of quenched steel, and—
- (1) Quenching temperature
- (2) Quenching medium
- (3) Size of piece quenched

Philadelphia, Dec. 3, 1921 WM. R. WEBSTER

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# Abstracts of Institute Papers

These papers will be presented in full in the Transactions.
An advance copy of these papers in full will be sent free to members on application, for which a request blank is furnished on page 18 of Advertising Section.
Discussion of papers invited.

## New Features in Structural Geology of the Anthracite Basins*

By James F. Kemp, New York, N. Y.

IN EARLIER years, the custom prevailed of regarding the anthracite basins as cases of folding with slight development of faulting. Folding is so pronounced and, in the eastern and western middle fields, at times so violent, that the inference was a natural one and led to the widespread impression that practically all the disturbances of the seams could be explained in this way. The cross-sections and maps prepared forty or more years ago for the Second Geological Survey of Pennsylvania, by Mr. Ashburner under Prof. J. P. Lesley, exhibit little else than folds.[1] So far as I can discover, faults fail in the charts, except in one small case in the Henry Colliery near Plainsville on the outskirts of Wilkes-Barre.

Several years ago, while spending a day or two in Wilkes-Barre, under the guidance of R. V. Norris, I looked over some recent and accurate cross-sections of a number of the large collieries and was deeply impressed with the peculiar behavior of some of the seams and the intervening shales. Thus, a seam might present a small, more or less overturned fold, rising 30 to 50 ft. above its general course, and yet the movement would be taken up in the overlying shales, so as hardly to be noticeable in the seams next above or below. These and similar anomalies, especially when shown with the accuracy of engineer's surveys, possessed great scientific and practical interest, bearing, as they do, not alone on coal mining, but on theoretical geology and the actual behavior of strata under great compressive stresses. In preparation for the semi-centennial meeting of the Institute, an effort was made to secure some of interesting sections for presentation. The collection shown was mainly due to Douglas Bunting of the local committee.

The illustrations are taken from all four of the main basins, but are chiefly from the portions nearest Wilkes-Barre. The first are in the southern part of the Northern, or Wyoming, Basin. The general geological section is as follows:

| | Anthracite Region | Western Pennsylvania |
|---|---|---|
| *Permian*..... | | Dunkard or Upper Barren Series |
| *Pennsylvanian* or *Carboniferous*..... | *Coal Measures* thickest in southern or Schuylkill Basin with about 20 coal seams. *Pottsville* Conglomerate, thickest in Schuylkill basin, with 6 coal seams. | *Monongahela* or Upper Productive Series, 6 coal seams. *Conemaugh* or Lower Barren series. *Allegheny* or Lower Productive series, 7 coal seams. *Pottsville* Conglomerate. |
| *Mississippian* or *Lower Carboniferous*... | *Mauch Chunk* red shales. *Pocono* sandstone. | *Mauch Chunk* red shales containing also the *Mauch Chunk* limestone. *Pocono* sandstone. |

The subdivisions of western Pennsylvania cannot be easily carried out in the anthracite basins, and correlation of the strata must be made chiefly by comparative study of the fossil floras of the seams, as has been in progress by Dr. David White. A stratigraphic feature of much importance relates to the present, or former more extensive, existence of Permian strata in the anthracite areas, because on this question and the determination of the section that has been removed by erosion, depends the amount of load carried by the anthracite coal measures when they were folded. The folds and overthrust faults are characteristic of relatively small load. Moreover, individual small folds often become larger and larger as we approach the surface from the deep workings, just as if, with diminution of load more extensive movements and adjustments became possible.

The northern, or Wyoming field, on the whole, is the least violently folded of the four main fields. The sections, however, make apparent that it has suffered from severe compression and that the easing of the strain has at times involved thrust faulting of great extent. An increased thickness of the geological section, together with sharply compressed, deep synclines, characterizes the southern field.

In the oral presentation of this paper, additional sections were shown as greater latitude was possible with lantern slides than is the case with the engraved figures. But the ones reproduced serve to bring out the main features. The existence of thrust faults

*Wilkes-Barre Meeting, September, 1921.

[1] There are several volumes on the Anthracite areas, listed as A-2 and A. A. The maps and cross-sections are folded in accompanying pockets, but also are to be found unfolded in the portfolios of the Grand Atlas, Division II, Parts 1 and 2.

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of a displacement to be measured on the dip of as much as 1000 ft. is the most important structural feature brought out. The tightly compressed and stretched folds, although more generally familiar, can never fail to be an object of interesting study to the geologist concerned with mountain-making processes. Where they can be illustrated from the engineers' surveys of the mines, they have an exact quantitative character of extreme value to the investigator. Some of the features commented upon cannot fail to suggest the conclusion that the anthracite measures did not rest under a great load when they were folded, but that they were fairly free to break and slip by, when strained beyond a moderate ability to resist.

## Storage-battery Locomotive as Applied to Mine Haulage*

By Charles E. Stuart, New York, N. Y.

A THOROUGH visualization of the subject would contemplate a comparative analysis of haulage machines and batteries of various types; the relationship of the storage-battery locomotive to other types of mine haulage should be considered and limiting factors in each case should be carefully developed. This paper will briefly deal with these factors.

About 1913, several large manufacturers sought to produce a reliable storage-battery locomotive. For two or three years, although a satisfactory battery and thoroughly substantial mechanical parts and motors were available, the development was slow, because of the failure of the manufacturers' thoroughly to understand mine requirements.

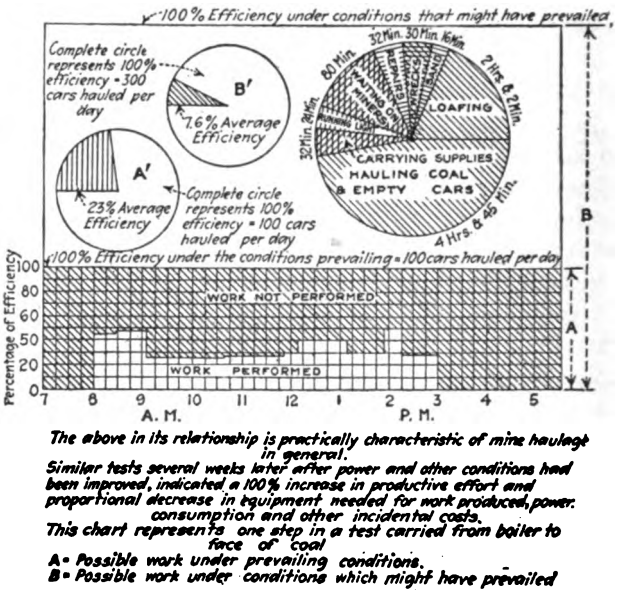
The interest of the mine owner in haulage is concerned solely in the number of tons of coal or ore that he can safely haul in a day and the cost per ton of this work.

In the coal mines having the lowest haulage costs there will be found: Entry trackage of not less than 40 lb. weight, well supported and well maintained on ties; room rails of 20 lb.; cars of the greatest cubical content permitted by the height of the seam (in low seams) or (in high seams) by the ease of loading. In well-managed soft-coal mines where the shovel is used, cars with a cubical content of 235 cu. ft. are found. The track gage is not less than 36 in. and usually is over 40 in. The trips contain from 25 to 50 cars and the main haulage locomotives are from 10 to 30 tons. There is double track on the main headings, good voltage at the working centers, the gathering locomotives are from 4 to 6 tons, and the workings are concentrated.

Within the car limits indicated, with a concentration of work, general grades not exceeding 6 per cent., the work for the storage-battery locomotive is collecting the cars from a number of places or rooms and taking them to a sliding where the trip is made up for the heavy locomotives.

Under these conditions, the storage-battery locomotive containing motors and batteries of ample capacity for the actual cycle of duty has the following advantages:

1. It is unnecessary to string trolley wire and bond tracks away from the main haulage ways.


100% Efficiency under conditions that might have prevailed
Complete circle represents 100% efficiency = 300 cars hauled per day
B'
7.6% Average Efficiency
A'
23% Average Efficiency
Complete circle represents 100% efficiency = 100 cars hauled per day
LOAFING
CARRYING SUPPLIES
HAULING COAL & EMPTY CARS
4 Hrs. & 45 Min.
100% Efficiency under the conditions prevailing = 100 cars hauled per day
Percentage of Efficiency
WORK NOT PERFORMED
WORK PERFORMED
A. M.
P. M.
The above in its relationship is practically characteristic of mine haulage in general.
Similar tests several weeks later after power and other conditions had been improved, indicated a 100% increase in productive effort and proportional decrease in equipment needed for work produced, power consumption and other incidental costs.
This chart represents one step in a test carried from boiler to face of coal
A = Possible work under prevailing conditions.
B = Possible work under conditions which might have prevailed

Graphic analysis of daily performance of locomotives.

2. In thin coal, it is unnecessary to brush; that is to take up bottom in order to make height necessary for mules.

3. No time is lost by making cable connections with the trolley on entering rooms, nor by cutting the reel cable and splicing it where cut.

4. The chance of personal contact with the trolley wire is absent.

5. In a gassy mine, away from the well-ventilated headings, the absence of a spark at the wheel or the trolley may be a vital consideration. In those mines where safety lamps are required, it is only a matter of time before the use of the trolley and reel locomotive for gathering will be prohibited. The storage-battery locomotive can be, and is being, made gas-proof and will pass the tests of the U. S. Bureau of Mines.

6. The speed and haulage capacity of the machine measured in pounds drawbar pull, will enable it to displace a number of mules and drivers and should materially lower the cost of gathering.

7. An invaluable consideration is the independence of the storage-battery locomotive with respect to either substation or power plant during idle days. At such times a storage-battery locomotive may be used for handling supplies or for other purposes.

*New York Meeting, February, 1922.

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The writer is now working on plans for a mine in which alternating current will be used for all stationary motor drives and for mining machines. For a short time, animal haulage will be the cheapest; but when the economic limit for this haulage is reached, it is proposed to purchase a charging set and storage-battery locomotives. In many cases, with a small mine, the storage-battery locomotive will be the most economical haulage unit for the life of the mine. With larger development, the third step would be the introduction of the heavy type of locomotive and the diversion of the storage-battery locomotive to gathering.

### Conclusions

To sum up, the storage-battery locomotive is proving a complete success and a means for reducing costs as well as risk of accident, where properly applied. Its failure at any mine will be accounted for by one of the following:

1. A duty cycle in excess of battery capacity; this has been the most frequent cause for failure.
2. Misapplication is a common error; that is, the effort to use the storage-battery locomotive where mule power is cheaper or where man power in conjunction with the strictly haulage type of locomotive would be cheaper.
3. Failure to select a locomotive that will stand the abuse of mine practice.
4. Failure to provide a reasonable amount of care and attention.

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## Malleableizing of White Cast Iron*

By Arthur Phillips, New Haven, Conn., and E. S. Davenport, Naugatuck, Conn.

THE purpose of this paper is to present certain data and observations resulting from a series of experiments dealing with the heat treatment and microstructure of commercial white cast iron and its derivative, malleable iron. A review of the literature leads to the belief that many data of a fragmentary character treating of the graphitization of white cast iron have been of little value, mainly because of the diversity in chemical composition of the materials employed in the tests. Moreover, when feasible, annealing periods at least comparable to those of current practice have been adopted.

In this paper the following subjects are discussed: Data on the thermal critical points of white cast iron and malleable iron; changes produced in tensile properties and microstructure of white cast iron by annealing at different temperatures within the range 760° to 1100° C.; relation of thickness of wall section of hard iron to microstructure and tensile properties of malleable iron obtained under normal annealing conditions. Notes on mechanics of graphitization of normal white cast iron as observed in specimens quenched after various periods of anneal at approximately 800° C.

The American "malleableizing" process consists essentially of a lengthy heat treatment at a moderately high temperature, followed by extremely slow cooling, with the object of converting the cementite of the white cast iron into graphite, or "temper" carbon, and ferrite. From the physicochemical point of view, the changes involved during this treatment are extremely complicated and are not thoroughly understood at the present time.

The exact temperature at which temper-carbon begins to form has been greatly disputed. This point is discussed in this paper and some experimental results bearing on the subject are offered.

The literature records the results of a number of investigators who have determined the critical temperatures of cast iron covering a wide range of composition; what seem to be the most significant and valuable data available are summarized in a table.

This series of experiments to determine changes produced in mechanical properties and microstructure of white cast iron by annealing at different temperatures within the range 760°–1100° C. was begun primarily to determine the effect of variation in temperature, of the order commonly found in commercial annealing furnaces, on the structure and tensile properties of the completely malleableized product.

The study of the microstructure of the bars tested leads to the following conclusions:

1. The ferrite grain size increases with the temperature and, probably, with the time of anneal.
2. The temper-carbon areas produced at the lower temperatures are more compact and sharply outlined than the graphitic areas obtained at the higher temperatures. High-temperature temper-carbon is, in general, characterized by a more or less porous structure of ragged and "spidery" outline. The higher temperatures have a disintegrating effect on the compact and rounded masses characteristic of carbon precipitated at the lower temperatures.

The manufacturer is interested in the effect of the rate of cooling of the hard casting on the mechanical properties of the malleable casting subsequently obtained (assuming constant chemical composition). Specimens were packed in sand and annealed and the resulting structure is shown in figures.

A comparison of the hard-iron structures and the corresponding malleable structures indicates that (1) the finer the hard-iron structures, the finer will be the ferrite grain and temper-carbon areas of the malleable iron; (2) the effect of the wall thickness, and therefore the rate of cooling of the white cast iron, is more pronounced in the case of the temper-carbon areas than in the case of the ferrite.

Although no tensile data were obtained in this experiment, direct comparison of the structures described with those corresponding to known tensile

*New York Meeting, February, 1922.

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properties leads to the conclusion that variations in wall section cause more pronounced variations in mechanical properties than can be attributed to the thermal gradient incidental to ordinary mill anneal. Doubtless poor mechanical properties are often obtained due to the additive effect of a very high annealing temperature and a heavy wall section.

Briefly stated, the completely cooled normal white iron consists of pearlite and cementite. There are, however, four kinds (from the viewpoint of origin and state of aggregation) of cementite, namely: massive pro-eutectic cementite, eutectic cementite, pro-eutectoid cementite, eutectoid cementite (pearlite).

In some instances, it is possible to distinguish all of these elements within a rather limited area; more often, however, we are unable to make these deductions with any degree of assurance.

Much has been written on the general subject of the graphitization of gray and malleable iron. The earlier investigators in this field apparently believed that it is essentially the structurally free and metastable cementite that decomposes at the higher temperatures to form ferrite and graphite, or temper carbon. More recently, however, several investigators, notably Storey, Archer, and Merica, have suggested the possibility of graphitization direct from solid solution. The writers have been of this opinion for some time and submit micrographs that, although not necessarily conclusive on this point, tend to indicate that under ordinary treatment of white cast iron temper-carbon is formed directly from the solid-solution areas and not, in general, from the massive cementite areas.

In these, and other observations made by us, the temper-carbon in quenched specimens seems to be coincident with the appearance of troostite or martensite. This would seem to signify that no appreciable amount of temper-carbon is precipitated until a saturated solution is formed.

As the time of anneal increases, the size and number of the temper-carbon areas increase, as might be expected. Although it is impossible to make any positive statement regarding the structural element giving birth to temper-carbon during the early stages of graphitization, we believe that in certain quenched samples, the temper-carbon was first precipitated in appreciable amounts in the solid-solution areas and not, in general, in the patches of massive cementite. As additional evidence there are inc uded four micrographs of specimens, one quenched after 21 hr. at 780° C. and the other quenched after 20 hr. at 800° C.

It is not unlikely that slight fluctuations in temperature during the effective annealing period may play an important part in the formation of temper-carbon. After the austenite has become saturated with carbon, whether it is in the form of cementite or as atomic carbon, a slight drop in the temperature would render the austenite supersaturated at the lower temperature and carbon would be rejected, apparently as temper-carbon. As temper-carbon is less soluble than cementite in gamma iron, when the temperature rises the austenite would become saturated at the expense of the structurally free cementite. Thus alternate precipitation and saturation takes place throughout the anneal; moreover, further separation of temper-carbon takes place during the slow cooling following the anneal since the solubility of carbon in austenite decreases with falling temperature. In properly annealed malleable castings little combined carbon can be found, either analytically or micrographically, and we are inclined to believe that the iron-graphite eutectoid is at approximately zero per cent. carbon.

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## Acid Open-hearth Process for Manufacture of Gun Steels and Fine Steels*

By W. P. Barba and H. M. Howe

WHEN this country went into the war, two concerns only, the Bethlehem Steel Co. and the Midvale Steel and Ordnance Co., knew how to make steel fit for great cannons, and at these concerns there were relatively few men who knew the whole art. Fortunately, certain of these men put their knowledge at the service of the Government, and proceeded to instruct the metallurgists at the arsenals and at various steel works.

At this time there were serious difficulties in the manufacture, for the Government, of aircraft and high-speed engine crankshafts, of certain ordnance forgings, and of shells for both the Army and Navy. There were indications that the source of some of the difficulties was the melting of the steel and the production of the ingot. Hence, steel melting and ingot production were first studied, in order to guide the wartime manufacturers to an even larger percentage of useful production from the steel initially melted.

Sections 1 to 11, inclusive, of the paper give a condensed statement of the subject, in particular indicating the chief ends to be held in view in conducting the open-hearth process for gun steel, while in the remainder of the paper, to and including section 58, these matters are elaborated.

1. *Composition.* In order to comply with the physical tests of American ordnance specifications, the composition of nickel-steel pieces for cannon and shafting should lie within the following limits, the exact composition varying with the part of the gun which the piece in question is to form, whether tube, jacket, hoop, or other.

| | Per Cent. |
|---|---|
| Carbon | 0.35 to 0.50 |
| Phosphorus | below 0.05 |
| Sulfur | below 0.05 |
| Manganese | 0.50 to 0.75 |
| Silicon | 0.15 to 0.30 |
| Nickel | 2.50 to 3.75 |

*New York Meeting, February, 1922

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For ease of exposition we have assumed a specific carbon content, 0.35 per cent.

The steel should be brought at the moment of teeming to the desired composition in every respect. (Throughout this paper tapping refers to pouring the steel from the furnace into the ladle, and teeming or pouring to pouring it from the ladle into the mold.)

(*a*) The manganese and silicon must be brought to the desired proportion. In order to do this, the bath should be freed from oxygen as nearly as possible and certainly to a constant degree. This freedom from oxygen is important also for lessening or preventing segregation, blowholes, and structural metallurgical weakness.

(*b*) Phosphorus and sulfur must be below the prescribed limit, and to this end the stock must be sufficiently free from them.

(*c*) The chromium and nickel must be within the prescribed limits.

2. *Temperature* must be accurately regulated, for reasons which appear in the following paragraphs.

3. *Segregation* must be restrained, and to that end the steel must be poured at a relatively low temperature and must be free from oxygen. (This represents American practice. In section 39, are considered the reasons that favor the opposite course of pouring at a high temperature, as is done in Continental Europe.)

4. *Columnar crystallization* must be restrained and the size of the dendrites kept down. To this end the teeming temperature should be relatively low.

5. *Piping* must be restrained. To this end, the ingots should be cast with the large end up, and at as low a temperature and as rapid a rate as the ingot sizes and the chemistry of the steel permit.

6. *External cracking* should be prevented. Here we may note that there are two periods of brittleness: First, when the steel is cooling toward the solidus, and thus is a viscous solid, an intimate mixture of a large proportion of already solid pasty particles and a relatively small proportion of still molten steel. Second, at the blue heat. The tendency in any given layer to crack in this period is often exaggerated by the simultaneous expansion which the deeper seated and slightly hotter layers are undergoing in passing through the recalescence.

We guard against this external cracking:

(*a*) By tapering the mold so strongly that the ingot frees itself from it readily during the contraction period immediately after pouring, and hence is readily withdrawn.

(*b*) By pouring at a relatively low temperature and slowly first, so that as the molten steel rises in the mold, the thickness of the already solidified walls may increase fast enough to withstand the increasing ferrostatic pressure, and second, that the size of the columnar crystals and the dendrites may be restrained.

(*c*) By fluting or otherwise shaping the outer surface of the ingot, which has little power of stretching, so that it can bend horizontally and thus accommodate itself to the resistance of the slower cooling and hence slower contracting interior.

7. *Internal Cracks Including Flakes* must be restrained: (*a*) By interrupting the relatively rapid cooling in the mold and replacing it with slower cooling in ashes as soon as the ingot has solidified sufficiently to be moved without danger of cracking. When the ingots are cast with the small end up, their molds may be stripped before they have cooled far enough to make it expedient to bury them in ashes. If this is done, the time between stripping and burying them forms a third portion of cooling.

(*b*) By saddening and thereby toughening the ingot very carefully, so as to prevent cracking it mechanically in forging or rolling. (To *sadden* an ingot means to substitute strong cohesion and toughness for its initial fragility, due to its having a very coarse crystalline sugar-like structure. This may be done by giving it a succession of light reductions under a hammer or press, or in a rolling mill. Sadden is evidently closely related to sodden.)

(*c*) By retarding the heating of the ingot for forging and that of the forgings themselves, so as to lessen the thermal stresses.

(*d*) By as great freedom from inclusions as possible.

8. *Retention of Inclusions* must be restrained. (*a*) By deoxidizing the molten steel as fully as possible by means of the carbon of the pig iron, because the product of its oxidation is gaseous and escapes, whereas those of all other deoxidizing agents are solid or molten and tend to remain as inclusions. In order that as much as possible of the deoxidation should be done by carbon, the working temperature during refining must be held as high as the safety of the roof will permit.

(*b*) The nearly complete deoxidation by carbon should be followed by further deoxidation by silicon. The manganese should not be added till after this silicon has done its work of deoxidation, in order that as little as possible of it may oxidize. This is both so that the manganese content of the product may be as nearly constant as possible, and that as little manganese oxide as possible may form to corrode the siliceous hearth of the furnace and form inclusions of manganese silicate with the silica so eaten away. This postponement clearly tends to lessen the oxidation of manganese; first, by shortening its stay in the furnace, and, second, by pre-oxidizing the bath with the silicon.

(*c*) The steel should be held in the ladle a moderate length of time to allow the inclusions to rise to the surface, and also for the much more important purpose of permitting the finished steel to fall to the proper temperature for casting into a successful ingot.

9. *Hot and Cool Pouring.* American practice, which is the chief subject of this paper, may be summed up briefly as Refining Hot but Pouring Cool. We have now seen four reasons for cool pouring:

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1. That it is thought to restrain segregation;
2. That it restrains the size of the dendrites;
3. That it lessens piping;
4. That it lessens or prevents external cracking.

On the other hand, it certainly favors the retention of inclusions, by shortening the time available for their rising to the surface in the ladle. Their opportunity to rise is really good only so long as the steel is completely molten. As soon as it cools to the liquidus, it ceases to be wholly molten and becomes an emulsion of an ever-increasing quantity of pasty particles of metal which have already solidified.

10. *The Furnace* must be protected. To the end,

(*a*) Its hearth should be protected from iron oxide by covering it, before charging the scrap, with about half of the pig iron used.

(*b*) The working temperature of the furnace must be maintained during the melting and refining periods at the highest point consistent with safety to the furnace: first, so as to shorten the melting period, during which the hearth is exposed to the attack of the iron oxide, because it is not fully covered by the molten charge; second, so as to stimulate the deoxidizing action of the carbon of the bath during the refining period.

11. *Recapitulation.* There are really only four purposes served by these various precautions, with their many sub-precautions, viz.: To make the ingots: (*a*) of proper and uniform composition; (*b*) of proper macro- and micro-structure; (*c*) sound, that is free from pipes, blowholes, cracks and roughness; (*d*) to prolong the life of the furnace.

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## Effect of Time in Reheating Quenched Medium-carbon Steel Below the Critical Range*

By Carle R. Hayward, Daniel M. MacNeil and Raymond L Presbrey, Cambridge, Mass.

At THE February, 1916, meeting of the Institute, a paper presented by Hayward and Raymond gave the results of a study on the effect of time in tempering medium-carbon steel, when the following conclusions were reached:

It is not fair to consider the question settled when only three specimens were used for each treatment, but the results obtained indicate that for reheating quenched medium-carbon steel to temperatures below 500° it is only necessary to heat it through. Longer heating has little or no effect on the tensile strength, ductility, or hardness. At temperatures above 500°, increasing the time of treatment causes a slight falling off in hardness and tensile strength with a corresponding increase in ductility.

In the discussion of the paper these conclusions were attacked and evidence presented that seemed to throw doubt on their accuracy. The authors, however, showed that this evidence was based on high-carbon or alloy steels and no facts regarding medium-carbon steel were presented.

* New York Meeting, February, 1922.

During this study the heat treatment was carried out in a small electric resistance furnace. It held nine specimens, but when these were placed in the furnace the temperature was lowered to such an extent that 30 to 40 min. were required to reach the desired heat. The authors pointed to this as a weak point in the investigation and it seemed wise to supplement the research by work on similar steel but using a different method of heating. This has been done and the results are given in the present paper.

The steel used in this investigation came in three bars ¾ in. in diameter; their analyses are as follows:

| Bar Number | Carbon, Per Cent. | Manganese, Per Cent. | Phosphorus, Per Cent. | Sulfur, Per Cent. |
|---|---|---|---|---|
| 1 | 0.46 | 0.56 | 0.010 | 0.055 |
| 2 | 0.44 | 0.58 | 0.007 | 0.042 |
| 3 | 0.48 | 0.58 | 0.007 | 0.048 |

The specimens were quenched at 850° C. and then reheated in lots of three for 5, 15, 30 min., 1, 2, and 4 hr. at 300°, 400°, 500°, and 600° C. Three specimens cooled in the furnace from 850° C. and three were tested in the quenched condition.

The bars were cut into 5½-in. lengths and heated in a No. 1 Oven furnace made by the American Gas Furnace Co. The furnace was heated to 900° C. and one hird of the specimens introduced on an asbestos board that was supported 2 in. above the bottom of the furnace. This lowered the temperature to about 800°, but after 20 min. it rose to 850°, at which point it was held for 10 min. Then the asbestos board was removed and the specimens quickly dumped into a tank of water. This operation was repeated until all but three of the specimens were quenched; these were allowed to cool in the furnace.

The quenched specimens were reheated, in lots of three, by immersing in a gas-heated pot containing about 75 lb. of type metal. The introduction of the specimens caused no appreciable change in the temperature of the metal and a constant temperature was easily maintained. The three specimens were fastened to an iron rod, to hold them below the surface of the metal and to facilitate their removal. After reheating for the desired time, the specimens were removed from the pot and quickly plunged into water.

In spite of the fact that great care was taken to secure uniform treatment of the three specimens in each set, some sets show erratic results. In four cases, the results were obviously low, so the figures were rejected. In all other cases the average of the three results was plotted in curves. The following points may be properly emphasized:

1. Even 5 min. heating of the quenched steel at 300° C. lowers considerably the strength and hardness and increases the ductility.

2. There is a marked increase in ductility in passing from the 400° to the 500° treatment without an equivalent lowering of strength; it is accompanied, however, by a change from an indefinite to a definite yield point.

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This was clear on the original load-elongation curves. Although the annealed specimens from the three bars showed the same yield point and ultimate strength, there was a difference in the ductility.

3. The specimens reheated to 600° C. are nearly as ductile as the annealed specimens, but they have an elastic limit about 60 per cent. greater.

4. In spite of several irregularities in the curves it is evident that reheating the steel for 1 hr. is all that is necessary and there are indications that for temperatures of 400° and below, ½ hr. is sufficient.

## Time to Pay Out as a Basis for Valuation of Oil Properties*

By W. Irwin Moyer, Pittsburgh, Pa.

TWO methods for the rapid valuation of oil properties are in common use. The one best known and most widely used is the "per barrel" value, based on the present daily production of the well, without regard to its past performance or the history of the sand or pool from which it produces. The second method is the "time to pay out," or the length of time required for a well to place itself upon the credit side of the ledger, from which time the returns from its production (less the operating expenses) will be clear profit.

The time basis for valuation is also commonly used in the appraisal of an undeveloped lease. In most oil fields, it is not thought good business to invest in production that will not pay out in at least 4 to 5 years. Nearly all buyers (except in certain regions of very persistent production like the deep-sand territory of the Appalachian field) expect wells to pay out in considerably less time than this.

Like the barrel per day price, the time necessary for a well to pay out has been determined for each field, so that one frequently hears a field or district referred to as having a certain time to pay out. This is considered the norm for that field or district and the buyer and seller base their value, to greater or less extent, on their belief in the accuracy of this time.

The writer long ago became convinced of the inaccuracy of the barrel per day method, except when greatly modified for local conditions, such as the age of the wells, their economic limit, operating conditions in the field, the future price of oil, and the persistence of the sand as a producer. When so modified, this method becomes more of an analytic or predicted probable yield valuation. While the appraiser may not go through each step in a valuation based on future returnable revenue, his knowledge of the field and the local conditions surrounding his leases make it possible for him to estimate a fair sales value that, in many cases, will be a close approximation to the truth. This is quite different from the commonly understood barrel per day value, in that the conditions surrounding the sale of one lease or property at a fair market value may be entirely dissimilar from those of a nearby property and the per barrel price of the first property will form no criterion of value for the second.

The present paper is the result of an investigation made to determine the reliability of the time to pay out as a basis for valuation. The data used were decline curves of production from several widely scattered fields in the United States, the curves being compiled from the production records of a large number of wells in the same field.

Conclusions from the curves and tables are:

1. The time to pay out varies in all fields.

2. For different fields, the decline curve is an important source of variation.

3. For the same pool or field, of the factors that vary, the time to pay out, sale price for oil and size of well are most important. Of much less importance are drilling and operating costs.

4. When properly modified for these variations, by use of a series of time to pay out curves, based on the decline curve of the field, the method is of value either as a supplement to a detailed appraisal or as a check on a rapid approximate valuation.

5. The method may be used in connection with a barrel per day value with much less likelihood of error than though the barrel per day is based on the flush production of the well. After the well has paid out, its production will be settled to a degree permitting a more liberal use of the flat barrel price.

6. The curves show at a glance: The minimum size of paying wells; the minimum sales price for oil on which average wells can be drilled; the influence on profits of a fall or rise in price for oil.

*New York Meeting, February, 1922.

## Subsurface Conditions on Portion of Arches Fork Anticline*

By Kenneth Cottingham, Columbus, Ohio

THE area described is situated on the Arches Fork anticline in Roane and Calhoun Counties, West Virginia. When the area was first mapped, it was expected that well records would give a more intimate idea of conditions, both structural and lithologic, than could be expected from surface horizons, but such has not proved to be the case. The surface formations are chiefly members of the Monongahela series, although the northern hilltop outcrops are of the Dunkard. Neither series offers a key horizon sufficiently definite to be satisfactory, although the structure as determined from well records was later checked against two of the more persistent surface sandstones.

In mapping the subsurface structure, the top of the Big Lime (Greenbrier) was employed as the key horizon. The average depth to the top of the Big

*New York Meeting, February, 1922.

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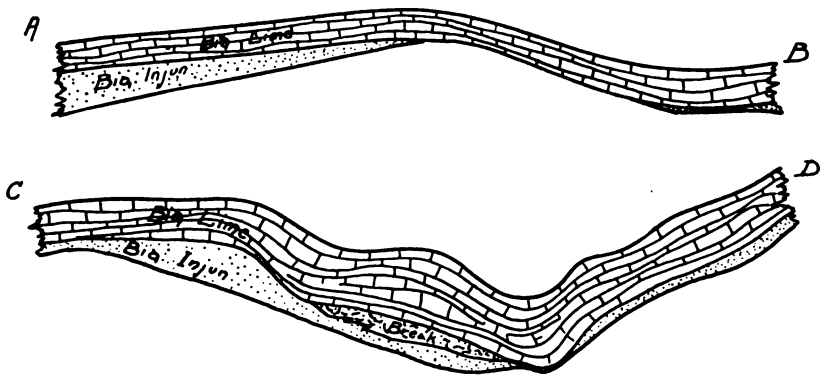
Lime varies from 1600 to 2000 ft., while the average thickness as indicated by well records is 113 ft. The oil-producing formation is the Big Injun, lying just below the Big Lime. In two instances, well records show the Lime and Injun separated by a few feet of "break." The Big Injun is recorded as having a variable thickness; seven logs report it as missing, and one gives it the maximum thickness of 105 ft. while the entire average for thickness is 19 ft.

The seven wells located near the anticlinal axis report the Big Injun as absent. They generally tend to show a thickening of the Injun on the flanks of the anticline, increasing with distance from the axis. Manifestly, this anomaly has no stratigraphic basis, as the actual thickness of the Big Injun and the overlying Big Lime was determined by original deposition which no amount of subsequent folding could appreciably alter. A skeleton map of structure and a cross-section showing the thickness of the Big Injun are given.




Cross-sections of Big Lime and Big Injun.

The recorded thickness of the Big Injun seems to have been based on the degree of show as an oil sand rather than on the actual amount of sand present. Recorded thicknesses of Injun in excess of 40 ft. undoubtedly include some Big Lime, and when the Injun is reported absent, it is probable that it was considered as part of the Big Lime.

It may be assumed that the Big Injun is more regular in thickness than the logs indicate, also that the actual thickness of the Big Injun bears no such direct relation to structure. Rather than defining the true thickness of the sand, cross-sections may indicate the attitude and capacity of a former reservoir from which the oil has retreated with a subsidence of the water level. The sand map shows that the apparent thickening of the sand, west of the no-sand area, balances the amount of dip on that side of the structure. Plotted in cross-section, it shows the base of the Injun dipping conformably with the top of the Big Lime, while the top of the Injun remains nearly level. This upper level undoubtedly lies in the basal portion of the Big Lime.

The no-sand area is slightly east of the anticlinal axis. Likewise, the oil sand is asymmetrical with respect to the structure, being thicker at a given distance on the western flank of the fold and lying structurally lower on the eastern flank. This again suggests an advance of water from the northwest, away from the axis of the Appalachian geosyncline. The minor thickening of the sand southwest of the no-sand area bears out the suggestion. The thickening of 20 ft. south of the same area is in part a break between the Big Lime and the Big Injun.

All the wells drilled along the axis of the anticline are reported to have yielded gas in some amount. None of the wells in the basin was commercially profitable and all were threatened by the water immediately after completion.

The evidence indicates an original advance of water from the northwest and a subsequent retreat in that direction. The leveling of the oil sand on the western flank of the anticline, the position of the no-sand area and the asymmetry of the sand with respect to structure, confirm this theory.

Whatever theoretical interpretation may be given to the facts, it is evident that an oil sand is frequently unreliable as a key horizon. In the present case, the sand indicates the extent and attitude of a former oil accumulation without giving an accurate conception of the structure.

## Investigation of Fatigue of Metals

A REPORT of the investigation of the fatigue of metals conducted by the Engineering Experiment Station of the University of Illinois in coöperation with the National Research Council, Engineering Foundation, and the General Electric Co., by H. F. Moore and J. B. Kommers, has been published by the University of Illinois, as Bulletin 124.

The introduction to the bulletin gives an outline of the inception of the investigation and of the method of work. During the war, the strength of airplane parts under repeated stress was of great importance. A short series of experiments on cold-dawn steel was made in the laboratories of the University of Illinois at the request of the National Research Council, which led to the investigation reported in Bulletin 124.

The national Research Council furnished an Advisory Committee to formulate general policies for the investigation; the Engineering Experiment Station provided a laboratory, the time of one member of its staff, and the use of much apparatus; Engineering Foundation first financed it, from the fund given by Ambrose Swasey; and, later on, the General Electric Co. contributed a sum of money that made possible the enlargement of the test party and the purchase of more equipment.

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# Institute Affairs

## The Common Purpose

AT THE beginning of the year, it is a custom of humanity to look forward and make resolutions in respect to the things that it is going to do during the coming year, and it would be well if the Institute, in common with mortals, should do this. It can do so, for it is just as human as are those who compose it. The Institute is its members; and as they plan, so does the Institute plan and function. It is merely a group of men with a common purpose; and what those men resolve to do, they can do. The common purpose has been well defined in the Constitution of the Institute, but the paths leading to the desired ends are several and as time passes more and more of them appear to open.

Whether the mining engineers should all follow one path or take up diverse ways leading toward those ends that we feel are most desirable is an open question. We cannot all see eye to eye, but we can nearly all see work that should be done. One member is studying flotation, he desires to make his results public and have them criticized; another is working on a new group of alloys with peculiar physical properties; another is troubled with legal matters, he knows that he is not receiving justice, why should the Institute not help to have the law changed? Strikes in his coal mines are the bane of another's existence. Unjust taxation and confiscation of his Mexican property are the troubles of another, and he wants to know why the Institute does not call the attention of Washington to Mexican mining conditions; and so it goes. Some of the work that we would do or would have done falls within proper but narrow boundaries, while some goes far afield, and yet the man who sees its necessity thinks only of the fact that this is something that should be done and that mining men should see that it is done.

Whether it is the Institute's business to concern itself in many things that are of interest to mining men may be questioned, but it cannot be questioned that every man should plan to do the work that he thinks needs doing, using the Institute so far as he may In many cases it can help him and it will hinder him only when he is decided y on the wrong track.

F. F. SHARPLESS.

## From the Columbia Local Section

THE following is quoted from a postal which has just reached the Secretary's desk:

**While you are asking yourself, perhaps, "What is the A. I. M. E. or the local section doing for me," stop long enough to inquire what you are doing for the Institute or the section. The local section is the opportunity for individual direction and impulse; it demands your support and invites initiative. It should be the forum of the best things of local interest and of greatest value to fellow members. Are the name and address on the obverse side correct?**

This contains so much in such compact form that it is well worth reproduction for the benefit of those who are members or who should be members of other sections. The question has come to many, especially to the younger members and a better answer could not be written.

F. F. SHARPLESS.

## Summary of Minutes of November Meeting of Board of Directors

AT THE meeting of the Directors of the A. I. M. E. on Nov. 16, 1921, there were present 11 Directors, 17 guests, the Secretary and the Assistant Secretary of the Institute.

A resolution was passed authorizing the Secretary to issue a letter asking all members to indicate those subjects relating to mining in which they are particularly interested, and the subjects in which they specialize. A file containing this information will be of great value to the officers and members of the Institute.

The matter of revision of the U. S. Mining Law was referred to the sub-committee on Mining Law for consideration and action.

Twenty-two Members, 15 Associates and 9 Junior Associates were elected, and two former members were reinstated.

The following resolutions were unanimously adopted:

RESOLVED, That the Committee on Membership be instructed, and it hereby is instructed to require that a member who has been dropped for the non-payment of dues must pay all arrears of dues and other indebtedness, with which he was charged on the books of the Institute at the time he was dropped, before his application for re-election may be considered by the Committee. And be it further

RESOLVED, That a candidate for reinstatement, whether he be one that has resigned in good standing or one who was dropped and subsequently settled his indebtedness, may be required to submit a record covering the period of his non-membership, together with endorsements, just as in the case of a new candidate. On approval of the committee, the candidate may renew his membership by the payment of current dues and without the payment of a new initiation fee.

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The name of William Kelly was substituted for that of John E. Hodge on the report of the Nominating Committee.

The Secretary was authorized to extend an invitation to the Mining and Metallurgical Society of America to hold a joint session with the Institute in February, if a satisfactory joint program is developed.

The following members of the Institute were elected to serve on joint activities: J. Vipond Davies, Board of United Engineering Society; John H. Janeway, member of Library Board; Herbert M. Boylston, member of Engineering Foundation; Herbert Hoover, member of John Fritz Medal Board of Award; George C. Stone, member of American Engineering Standards Committee.

By far the greater part of the meeting was devoted to a discussion of the budget for the year 1922. It is expected that the income of the Institute will be considerably less for the year 1922 than for the year 1921; hence some of the items of the budget for next year must be materially reduced, and the discussion was in respect to the items which should be reduced. It is hoped that the Finance Committee will have in hand sufficient data by the time the Board meets in January so that the budget may be submitted in its final form.

After authorizing the bills for the 1922 dues, the meeting adjourned.

## Transactions of the Electrical Engineers

PRESSURE on the finances and budget of the American Society of Electrical Engineers has led that society to take an unprecedented step in regard to the publication of their technical papers and the TRANSACTIONS.

This is a subject of vital importance to all societies, particularly at this time, when all are suffering more or less financial pressure. It has been thought wise to acquaint the members of our Institute with the steps taken by the electrical engineers, not with any intimation that a similar course may be followed by our Institute, but so that in their various considerations of our own problem they may be advised as to what other societies are doing in this respect.

### A. I. E. E. TRANSACTIONS

An important change in the policy to be followed in the distribution of the annual TRANSACTIONS of the Institute has been adopted, as explained in a notice issued to all members of the Institute under date of Nov. 12.

The volume covering the year 1920, publication of which has necessarily been delayed for financial reasons, is now completed and will be forwarded to all members entitled to receive a copy, during the month of December, 1921.

The new policy takes effect with the volume covering the year 1921 in accordance with the following resolution which was considered and approved by the Board of Directors at a meeting in October, 1920:

VOTED, that commencing with the volume of Institute TRANSACTIONS covering the year 1921, the practice of furnishing acopy of the TRANSACTIONS to each member of the Institute be discontinued, and that copies be furnished to all members who subscribe in advance at a price to be determined later, possibly $5 per year; the edition to be determined by the advance subscriptions received, with a reasonable allowance for stock to meet future demands.

The immediate occasion of the above action was the condition of the Institute's finances, caused by continuing all the activities of the Institute, at prevailing increased costs, without increasing the annual dues. The action was adopted after learning, through the Development Committee and through conference with the representatives of the various Sections at recent annual conventions, the attitude of the membership regarding the publications of the Institute.

The greatly increased cost of publishing the JOURNAL and TRANSACTIONS, together with the increased amount of suitable material available for publication, has rendered it necessary that the policy outlined above be now put into effect, and the following plan has been decided upon by the Board of Directors in connection with the 1921 and 1922 TRANSACTIONS

1921 TRANSACTIONS. This volume of the TRANSACTIONS is about to go to press, and the edition will be determined by the number of subscriptions received by Jan. 1, 1922, in response to the circular mailed to the membership Nov. 12. The price of the TRANSACTIONS will be $3 to the membership only. (The regular price to non-members will still apply.)

1922 TRANSACTIONS.—Commencing with this volume it has been decided to print each month in conjunction with the printing of the JOURNAL additional pages to be reserved and bound at the end of the year to form the volume of the TRANSACTIONS for those members who desire a file of papers and discussions in this form. The practice of printing discussions in the JOURNAL will be reestablished. The material to be contained in the TRANSACTIONS will be selected exactly as heretofore, the only difference in the volume being in the size of the pages, as pages from the JOURNAL will become identical with pages in the TRANSACTIONS, with the exception of a required change in folio numbers.

The edition of the TRANSACTIONS for 1922 will be based upon the number of members who make application therefor by Jan. 1, 1922, at the nominal price of $2 per year to the membership only.

The adoption of the above policy, resulting in the saving of a large portion of the expense caused by duplication of printing, will permit of the publication of additional desirable material, particularly relating to the activities of the Sections, and the further development of the JOURNAL in accordance with the policy decided upon in the fall of 1919, in response to the expressed wishes of the membership.

Each member who desires a bound copy of either the 1921 or 1922 TRANSACTIONS or both, is urged to make prompt application therefor, as only a limited number of surplus copies will be printed.

## Members, Please Note

REDUCED return fare in connection with the annual meeting may be obtained under the conditions noted on page 40. Read these conditions for the sake of the far-away members, if not for your own benefit. The amount of money involved will be small for those who live near New York, but unless they ask for the reduction members from distant points may be deprived of it.

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# February Meeting Plans

IN THE December issue of MINING AND METALLURGY, attention was drawn to the February meeting of the Institute. The plans of the Committee on Arrangements have progressed considerably since that date, so that further announcements may now be made.

The Mining Methods Committee has definitely arranged for at least three sessions. One of these will be devoted to a discussion of various methods used in sampling large low-grade ore deposits; a second will have for its leading subject underground transportation and mining practice as developed by the Anaconda Copper Mining Co., and the third will be devoted to the coal industry, particularly in reference to the percentage of economic recovery under various conditions.

The Mining Methods Committee will also hold a committee meeting, which will be open to all members, for the purpose of a discussion in reference to the symposium on mining methods which it proposes to hold at an early meeting.

The Petroleum and Gas Committee is planning a two-day symposium. A tentative program was printed in the November number of MINING AND METALLURGY, and this, with a few changes, still indicates the plans of the committee. E. L. DeGolyer, vice-chairman of the committee, says:

> Mining engineers and geologists should make every effort to attend the February meeting and hear the symposiums on foreign oil possibilities which have been arranged by the Petroleum and Gas Committee of the Institute. No such comprehensive consideration of this subject as that planned has previously been attempted.
>
> This matter is extremely important to all persons who are users of petroleum or its products, and in our present civilization this classification includes every individual, but it is particularly important to the engineer who directs the production and use of power on a large scale.
>
> The United States produces currently about two-thirds of the world's oil but consumes more than it produces. We must look to outside areas for part at least of our petroleum requirements and the future market, because even American oil will be influenced largely by the ease and freedom with which this outside supply may be secured.
>
> It is important to you to know something of foreign prospects and conditions under which they may be developed.

As noted below, the Excursion Committee is providing for excursions to nearby petroleum refineries and plants where a variety of petroleum products are being manufactured.

The Iron and Steel Committee has planned several sessions. The paper by W. P. Barba and H. M. Howe, the Report of the Ingot Committee of the National Research Council on Acid Open-hearth Process as Practiced in America in the Manufacture of Gun Steels and Fine Steels Generally, will be presented at one session. This is one of the most informative papers on the open-hearth that has appeared in any literature for many years, and in connection with the paper by W. J. Priestley, on Effect of Sulfur and Oxides in Ordnance Steel, will be a fruitful source of discussion. The paper by W. R. Webster, Application in Rolling of Effects of Carbon, Phosphorus and Manganese on Mechanical Properties of Steel, will be a feature of one session. The subject has been of so much interest at Institute meetings in former years, and new researches have advanced it so greatly, that considerable discussion is expected.

In addition to the above, there will be papers on Effect of Time in Reheating Quenched Medium Carbon Steel Below the Critical Range, by C. R. Hayward, D. M. MacNeil and R. L. Presbrey, on Malleableizing White Cast Iron, by Arthur Phillips and E. S. Davenport, on Effect of Quality of Steel on Case Carburizing Results, by H. W. McQuaid and E. W. Ehn.

The Iron and Steel Committee will also hold a memorial meeting for J. W. Richards, chairman of the committee for many years.

Iron and steel men will be interested to know that the first Hunt medal will be given to Captain Hunt at the annual banquet, it having been already officially presented to him with appropriate ceremonies, and that Captain Hunt's portrait, by Emil Fuchs, will be presented to the Institute by his friends in the membership.

The Mining Committee of the National Safety Council will hold two sessions in connection with the Institute meeting, one of which will be devoted to hoisting, hoisting ropes and equipment; the other, to mine ventilation.

The Institute of Metals Division expects to hold two sessions. During one of the sessions, papers procured by the Division will be presented, and during the other certain work of the Bureau of Standards will be discussed. It is hoped, also, that during the meeting this group will be able to present the first of a series of annual lectures; the subject and the lecturer will be announced later.

It is hoped that sessions may also be arranged for discussion of non-metallic minerals.

There will be a convention of representatives from all the local sections, and opportunity will be offered for a meeting of all of the committees some time during the week.

The Excursion Committee plans visits to industrial plants near New York, dividing the excursion into three divisions—steel, copper and oil. The plans are for the steel group to visit the Crucible Steel Co. and the Pardee Steel and Tile Works, for the oil group to go to the Standard Oil plant at Bayway and the Chese-

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brough Mfg. Co. or the Barber Asphalt Co.; and the copper group to visit the U. S. Metals Refining Co. at Chrome and possibly the Raritan Copper Works. Though all members with their ladies and guests can be accommodated in one or another of these divisions, a limited number only can be taken in any one division. It is requested, therefore, that members write as soon as possible to the chairman of the Excursion Committee, stating which division they wish to attend and how many ladies and guests they anticipate will accompany them. Address: Mr. R. W. Deacon, c/o U. S. Metals Refining Co., Chrome, N. J.

The Hotel Committee has reserved a limited number of rooms at five hotels as follows:

| | Single Rooms | | Double Rooms | |
|---|---|---|---|---|
| | With Bath | Without Bath | With Bath | Without Bath |
| Belmont..... | $6 up | $3.50 | $9 | $6 |
| Commodore..... | 4.50 up | | 6.50 up | |
| McAlpin..... | 4.50 up | | 8.00 up | |
| Pennsylvania..... | 4.50 up | | 6.50 up | |
| Waldorf..... | 6.00 up | | 9.00 up | |

Only a few rooms are available at the minimum rates but the committee will do the best possible to secure accommodations at prices desired. Members wishing accommodations at other hotels will be served, if possible. All applications should be made to Mr. Wilber Judson, c/o M. P. Guilfoil, 14 Wall St., New York, at as early a date as possible. No promise can be made for late reservations, though the committee will gladly do the best it can for members unable to make an early decision to attend. Washington's Birthday occurs in Institute week this year, therefore the hotels will be crowded.

On Monday evening, Feb. 20, a smoker will be held at the Institute building.

No program will be fixed for the evening of the 21st but arrangements have been made to secure theatre tickets in blocks for those who wish to attend in small parties of their own.

A number of the committees will also hold their meetings at dinners on the evening of the 21st; arrangements have been made for dinners of the Petroleum and Gas Committee, the Milling Methods Committee, and the Institute of Metals Division, and others are under consideration.

The annual banquet of the Institute will be held at the Pennsylvania Hotel on the evening of the 22nd. Announcements of this dinner and reservation cards will be sent to members in January.

## Reduction in Railroad Fares

The Institute has made arrangements whereby reduced rates will be granted, to members and dependent members of their families attending the meeting, for *return* railroad fares on most railroads in the United States, except from the states of Washington, Oregon, Nevada and California (these may be arranged for before the time of the meeting), on the following conditions. Keep in mind the fact that although the reduced fare may not be of importance to you, it may mean a great deal to the more distant member, and that it will not be granted to any one unless at least 350 certificates are validated. Members living near New York are urged to obtain certificates, so that those coming from a greater distance may secure the benefit of the reduced rate.

### *How to Obtain the Reduced Fare*

1. Tickets at the regular one-way adult tariff fares for the journey to New York must be purchased on certain specified dates. Some railroads will sell these tickets from Feb. 16 to 21; others will sell them from Feb. 16 to 22. Be sure that when purchasing your going ticket you request a "certificate," not a "receipt."

2. Present yourself at the railroad station for ticket and certificate at least 30 minutes before departure of train on which you will begin your journey.

3. *Certificates are not kept at all stations.* Inquire at your home station; the agent will inform you at what station they can be obtained. You can purchase a local ticket to the station which has certificates in stock and there purchase a through ticket and obtain a certificate.

4. Immediately on your arrival at Institute headquarters, present your certificate to the endorsing officer, John T. Breunich, as the reduced fare for the return journey will not apply unless you are properly identified as provided for by the certificate.

5. The special agent of the railroads will be in attendance on Feb. 22, to validate certificates. If you leave for home prior to his arrival, or if you arrive at the meeting after he has left, you cannot have your certificate validated and therefore you will not obtain the benefit of the reduction on the home journey.

6. The reduction on the return journey is not guaranteed, but is *contingent on an attendance of not less than 350 members and dependent members of their families*, holding regularly issued certificates obtained from ticket agents at starting points, showing payment of regular one-way adult tariff fares of not less that 67 cents on going journey.

7. If the conditions are met, you will be entitled, up to and including Feb. 27, 1922, to a return ticket *via the same route* over which you made the going journey at one-half of the regular one-way adult tariff fare from the place of meeting to the point at which your certificate was issued.

8. Return ticket issued at the reduced fare will not be good on any limited train on which such reduced fare transportation is not honored.

The Committee on Arrangements for the annual meeting is as follows:

Chairman, William Young Westervelt
Vice-chairman, Robert Linton
Secretary, E. L. Gruver

| | |
|---|---|
| C. C. Burger | Albert C. Ludlum |
| John A. Church, Jr. | Harris K. Masters |
| William C. Coffin | John A. Mathews |
| Ralph W. Deacon | A. J. McNab |
| Everette L. DeGolyer | Carl A. Meissner |
| J. V. N. Dorr | P. A. Mosman |
| Karl Eilers | Herman A. Prosser |
| Fred Hellmann | R. M. Raymond |
| Louis D. Huntoon | Sidney Rolle |
| C. V. Jenkins | Forest Rutherford |
| Wilber Judson | Bradley Stoughton |
| Donald M. Liddell | Arthur L. Walker |
| Richard L. Lloyd | Daniel A. Welch |

Mrs. Arthur S. Dwight

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# New Amendments to Institute By-Laws

At the meeting of the Directors of the A.I.M.E. on Dec. 16, amendments which had been before the Board for three months were adopted. The former and the amended sections are as follows. Words from the original By-Laws omitted from the amendments are printed in italics and additions in the new By-Laws are printed in bold face type.

ORIGINAL BY-LAWS

BY-LAW I. P. 3

BY-LAW III. P. 1

The Secretary shall keep a record of the proceedings of all meetings of the Institute. He shall be custodian of the corporate seal, of the minute books and of all legal documents belonging to the Institute. He shall have charge on behalf of the Institute, of all correspondence *except such as pertains directly to the office of the Treasurer.*

P. 3

The Secretary shall be custodian of all technical or scientific papers submitted to the Institute for its consideration, shall have general charge and supervision of the editing and proofreading of all material published by the Institute and of the distribution thereof, *and be ex-officio Chairman of the Committee on Publications.*

P. 5

The Secretary may, with the approval of the Board of Directors, employ such persons as are necessary to constitute a clerical *and office* force, at such salaries as shall be approved by the Board of Directors or its Executive Committee. He shall be the immediate *superior* of all such employees.

P. 6

BY-LAW IV. Addition

BY-LAW V. P. 1

The Treasurer shall *collect* and, under the direction of the Board of Directors, shall disburse all funds of the Institute. He shall keep regular accounts in books belonging to the Institute, which shall be open to any member of the Board of Directors. He shall report in writing at each annual meeting of the Institute, and at every regular meeting of the Board of Directors the balance of money on hand, and any existing appropriations which may affect the same.

P. 5

BY-LAWS AS AMENDED

BY-LAW I. P. 3

**The president shall do and perform such other duties as may from time to time be assigned to him by resolution of the Board of Directors of the Institute.**

BY-LAW III. P. 1

The Secretary shall keep a record of the proceedings of all the meetings of the Institute. He shall be custodian of the corporate seal, of the minute books, and of all legal documents belonging to the Institute. He shall have charge on behalf of the Institute of all correspondence.

P. 3

The Secretary shall be custodian of all technical or scientific papers submitted to the Institute for its consideration, and shall have general charge and supervision of the editing and proofreading of all material published by the Institute, and of the distribution thereof.

P. 5

The Secretary may, with the approval of the Board of Directors, employ such persons as are necessary to constitute a clerical force, **including employees of the Accounting Department,** at such salaries as shall be approved by the Board of Directors or its Executive Committee. He shall be the immediate **supervisor** of all such employees.

P. 6

**The Secretary shall do and perform such other duties as may from time to time be assigned to him by resolution of the Board of Directors, and the Directors shall have power, by resolution, to take from the Secretary and to delegate to any other officer any of the duties of the Secretary.**

BY-LAW IV. Addition

**The Assistant Secretary shall do and perform such other duties as may from time to time be assigned to him by resolution of the Board of Directors, and the Directors shall have power, by resolution, to take from him and to delegate to any other officer any of the duties of the Assistant Secretary.**

BY-LAW V. P. 1

The Treasurer shall **receive** and, under the direction of the Board of Directors, shall disburse all funds of the Institute. He shall keep regular accounts in books belonging to the Institute, which shall be open to any member of the Board of Directors. He shall report in writing at each annual meeting of the Institute, and at every regular meeting of the Board of Directors, the balance of money on hand, and any existing appropriations which may affect the same.

P. 5

**The Treasurer shall do and perform such other duties as may from time to time be assigned to him by resolution of the Board of Directors, and the Directors shall have power, by resolution, to take from him and to delegate to any other officer any of the duties of the Treasurer.**

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BY-LAW VI. P. 1

The Board of Directors may appoint an Assistant Treasurer, to whom it may delegate the duties *of conducting, under the supervision of the Treasurer, correspondence incidental to the office of Treasurer, of collecting*, receiving and depositing in bank, to the credit of the Institute, all moneys, and of paying out of a special account, if entrusted to him, the smaller current expenses of the Institute, subject to the instructions of the Treasurer. He shall hold no other office.

P. 2

BY-LAW VII. P. 4

The Committee on publications shall consist of the Secretary of the Institute, *who shall be its Chairman*, and at least twelve members of the Institute, to assist in passing on all papers offered for publication. They shall be appointed annually by the Board of Directors.

BY-LAW X. P. 1 (a)

On receipt of a paper by the *Secretary* (Chairman), he shall send it to the member of this Committee who, in his judgment, is most competent and available to pass upon it as "Reader," accompanying the paper with his own opinion of its suitableness for publication, and any other pertinent information.

P. 3

In case the *Secretary* is unable to secure a decision as to the suitability or unsuitability of a paper for publication, as directed in Section 1 before the time of announcing the program of a meeting, he may at his own discretion place the paper upon the program of the meeting, or refuse it a place thereon.

P. 4

The Secretary, being Editor of the Publications of the Institute *as well as Chairman of the Committee on Papers and Publications*, and being charged with the duty of seeing that expenditures authorized for publications by the budget are not exceeded, shall have the right to veto the publication of any paper. This veto may be reviewed by the Directors upon application.

BY-LAW XXII. Sec. 1

*Amendments to these By-Laws may be made* by vote of a majority of the Directors, *provided the amendments have been proposed by a member of the Board at a previous meeting of the Board and copies of the same sent to all members of the* Board at least 20 days before the meeting at which they are to be voted on, *and an expression of opinion invited thereon. At a later meeting they may be amended in form, but not in substance.*

BY-LAW VI. P. 1

The Board of Directors may appoint an Assistant Treasurer, to whom it may delegate the duties of receiving and depositing in bank to the credit of the Institute, all moneys, and of paying, out of a special account, if entrusted to him, the smaller current expenses of the Institute, subject to the instructions of the Treasurer. He shall hold no other office.

P. 2

**The Assistant Treasurer shall do and perform such other duties as may from time to time be assigned to him by resolution of the Board of Directors, and the Directors shall have power, by resolution, to take from him and to delegate to any other officer any of the duties of the Assistant Treasurer.**

BY-LAW VII. P. 4

The Committee on Publications shall consist of the Secretary of the Institute, and at least twelve members of the Institute, to assist in passing on all papers offered for publication. They shall be appointed annually by the Board of Directors.

BY-LAW X. P. 1 (a)

On the receipt of a paper by the Chairman, he shall send it t the member of this Committee who, in his judgment, is most competent and available to pass upon it, as "Reader," accompanying the paper with his own opinion of its suitableness for publication, and any other pertinent information.

P. 3

In case the Chairman is unable to secure a decision as to the suitability or unsuitability of a paper for publication, as directed in Section 1, before the time of announcing the program of a meeting, he may at his own discretion place the paper upon the program of the meeting, or refuse it a place thereon.

P. 4

The Secretary, being Editor of the publications of the Institute and being charged with the duty of seeing that expenditures authorized for publications by the budget are not exceeded, shall have the right to veto the publication of any paper. This veto may be reviewed by the Directors upon application.

BY-LAW XXII. Sec. 1.

**The Board of Directors shall have power to make, amend, and repeal these By-Laws,** by a vote of a majority of all the Directors, **at any regular meeting of the Board, PROVIDED, that notice of intention to make, amend, or repeal the By-Laws in whole or in part, shall have been given at the next preceding meeting, and copies of such amendments shall have been sent to all the members of** the Board at least (20) days before the meeting **at** which they are to be voted on.

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# Activities of Local Sections and Affiliations

## Colorado Section Meets with Students

A JOINT meeting of the Colorado Local Section and the affiliated student society of the Colorado School of Mines was held at the armory in Golden on Nov. 22, at 6:30 p. m. Chairman Parker presided and 175 members and guests were present. Some members of the local section were seated at each table, so that the older members might become acquainted with the newer ones.

The meeting was opened by the singing of the "Star Spangled Banner." Grace was said by the Rev. G. L. Lehman. An excellent dinner was served by the ladies of the Episcopal Church, and during the dinner a number of popular songs were sung under the leadership of Lewis B. Skinner. After dinner the School of Mines band, led by Professor Bellis, rendered a number of selections.

Chairman Parker briefly explained the organization of Colorado Engineering Council and its plans for a Municipal Stadium and Engineer's Building in Denver, and H. B. Barnes outlined the idea of the proposed Engineers' Building. By request of Engineering Council, the chairman was directed to appoint a committee of three to confer with similar committees of the other member organizations of Council regarding plans for the building.

Arthur Thacher, of St. Louis, gave a delightful address in which he outlined the work that lies before engineers in coöperating with other agencies of civilization in assisting the progress of humanity. Mr. Thacher spoke of the important work that can be done by the Institute, and emphasized the necessity for individual responsibility.

President Alderson, of the School of Mines, T. S. Harrison, president of the School of Mines Alumni Association, Theodore Marvin, chairman of the School of Mines student society, Max Ball and Judge Stimson, spoke briefly regarding the benefits derived from membership in the Institute.

The "Skyrocket Cheer" was used in connection with the introduction of the speakers. This, in a certain sense, corresponds to the English Herald's announcement of a speaker or toast, but is considerably more lively.

## Geology of Spokane Region Studied by Columbia Section

ABOUT forty members and guests attended the November meeting of Columbia Local Section. Ivan de Lashmutt presided. Thomas Large, of the department of science of Lewis and Clark High School, read a paper on the Geology of the Spokane Region. This was discussed by Thomas A. Bonser, F. A. Thomson, F. M. Handy, Russell Collins, J. H. Eby, and others, who, although they agreed as to the principal physiographic features and doubted the presence of petroleum in commercial quantities, did not agree on the subject of the historical geology of the area. The same topic will be discussed at another meeting.

## Tulsa Section Nominations

NOMINATIONS for officers of the Tulsa Section for the year 1922 are:

Chairman—H. B. Goodrich, Tulsa, Okla.
Vice-chairmen—J. A. Udden, Austin, Tex.
Wallace E. Pratt, Houston, Tex.
Sidney Powers, Tulsa, Okla.
Sec.-treas.—Robert H. Wood, Tulsa, Okla.
Executive Committee—Alf. G. Heggem, Tulsa, Okla.
W. R. Hamilton, Tulsa, Okla.
Alexander Deussen, Houston, Tex
Charles H. Taylor, Oklahoma City, Okla.

## Southern California Section Begins Year's Work with Vigor

THE first meeting of the Southern California Section, this year, was held on Oct. 13. The real "get-together," "get acquainted" meeting started at 5.15 p.m. at the offices of the Western Precipitation Co. in Los Angeles. There, as guests of Walter Schmidt, chairman pro-tem of the section, the members were received and entertained. Each member, on entering the offices, was branded and instructed to roam at will through the numerous offices, laboratories, shops and drafting rooms. His brand was an introduction to every other member, his duty was to get acquainted. The company had its laboratory in full operation, giving a practical demonstration of its process of anti-precipitation and oxidation. This was keenly appreciated and enjoyed by all members.

This preliminary meeting insured the success of the dinner and business meeting that followed at the California Country Club, where 95 members and guests sat down at table. Chairman Schmidt announced informally that there should be more "pep" injected into the meetings, that there was much latent talent for entertaining among its members and that the old college spirit should be revived and exercised. He

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called for volunteers to entertain by story and song. The response was fairly generous and the applause showed genuine appreciation and enjoyment.

At the conclusion of the dinner, the business meeting was called to order by the chairman. Mr. Schmidt explained that he was occupying the chair because the elected chairman, Harvey Mudd, had been called to Europe.

By resolution, the section approved the proposed constitution of the Federated California Technical Societies and its administrative body, the California Technical Council, and instructed its officers to arrange to have the section join the federation.

Horace V. Winchell, who was welcomed both as a past president of the Institute and as a new member of the local section, made an address on the Relation of Mining to Business. The unanimous opinion, brought out in discussion, was that Mr. Winchell's paper contained a prophetic message to the general public as well as to mining engineers, and that it should be published in the daily press. It appeared in the *Los Angeles Times*, Oct. 16, 1921.

Mr. Rogers, vice-president of the Merchants National Bank and Mr. Pettingell, president of the Los Angeles Stock Exchange, guests of the evening, gave interesting short talks.

As an epilogue to this meeting, Ira Remsen presented an animated puppet show entitled "The rock hounds of Ventura or the petroliferous pups," starring our fellow member, Harry Johnson, assisted by a company of six.

The November meeting of this section was held on Nov. 18, at the Canterbury Inn, Los Angeles. During the dinner attended by 54 members, a number of questions of general interest to the Southern California Section were discussed and the executive committee was authorized to arrange for a weekly "round table" at the Hoffman Cafe at luncheon time on Wednesday.

An outdoor meeting and barbecue, possibly at Topango Canyon, was suggested and was referred to the entertainment committee.

Mr. Nevius reported on the status of the real estate license law. He said that this matter is of vital interest to every engineer in California and should be followed up; the chairman therefore re-appointed Mr. Nevius as a committee of one to keep in touch with this subject.

It was moved and seconded that a committee of three be appointed by the chairman to study and report on the Bureau of Mines bill that is now before Congress.

Doctor Wood of the Carnegie Institute gave an interesting talk on Earthquakes and Prominent Fault Zones of the Pacific Coast, which was followed by brief discussion led by Doctor Ralph Arnold and Harry Johnson. The second speaker, Mr. LaRue of the United States Geological Survey, spoke on the Colorado River Power and Irrigation Project and showed some fine slides.

## Seattle Engineers Club Open to Institute Members

THE Puget Sound Section invites all members of the Institute who are planning to visit Seattle to write or wire the Engineers Club of Seattle, 5th and Seneca Streets, for reservations, saying in the application that they are members of the A. I. M. E. The officers of the local section will see that these visitors are supplied with guest cards and that the full privileges of the club are extended to them. The new club house has 22 rooms for guests in addition to library, billiard room, dining room and other rooms for general use.

The Puget Sound Section of the A. I. M. E. holds its meetings at the Engineers Club, and the local sections of the other national engineering societies also meet there. It is hoped that, eventually, an Engineers' Building may be erected in Seattle, to be the headquarters of the engineering activities of the city.

ENGINEERS CLUB, SEATTLE, WASH.

The section held a meeting on Nov. 26, at which the subject of discussion was the bill on the revision of the mining law now before Congress.

A 60-lb. fruit cake was sent to Herbert Hoover at Thanksgiving. The emblem of the Institute was placed on the cake and the accompanying card read "From the Puget Sound Section, American Institute of Mining and Metallurgical Engineers."

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## What Can be Done to Revive the Mining Industry

THE regular monthly meeting of the New York Section was held at the Machinery Club on Wednesday, Dec. 7. The subject of the meeting, which was preceded by the usual informal dinner, was "What Can be Done to Revive the Mining Industry." The speakers of the evening were C. F. Kelley, president of the Anaconda Copper Mining Co. and Thomas H. Watkins, president of the Pennsylvania Coal & Coke Corpn., whose speeches will be printed *in extenso* in this magazine. They were followed by an impromptu address by Dr. Richard Moldenke, who has recently returned from several months in Germany. He discussed the inter-relation of American business and its

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recovery with the recovery of European conditions, which at present are very difficult.

The attendance at the meeting was about 125. Dr. R. M. Raymond presided.

The New York Section will hold its next meeting on Jan. 11, at the Machinery Club. The dinner will be at 6.30, and the program at 8 p. m. The subject before the meeting will be "Compulsory Licensing of Mining Engineers."

## Affiliated Student Societies

**Miner's Club,** University of Arizona, held its first meeting of the year early in November, and elected the following officers: president, Speed Bugbee; vice-president, Ernest Hansen; secretary, George Roseveare; treasurer, Jack Still.

**School of Mines Society,** Columbia University, has resumed activities. The officers are H. Potter, president; M. Tynan, vice-president; H. Wachsmann, secretary.

**John Markle Mining Society,** Lafayette College, held its second meeting of the year on Nov. 2. Dr. G. B. Shattuck, acting professor of geology in the absence of Professor Peck, gave a most interesting talk on his adventures in the Bahama Islands. He went there as head of a geological and geographical expedition sent out by Johns Hopkins University. Doctor Shattuck told of starting from Baltimore on a two-master, accompanied by a number of men who had never been to sea before. He explained the formation of the coral reefs and described the wonderful plant and animal life. He told several shark stories, described his experience with mosquitoes, and his contact with leprosy, concluding with a few suggestions for safeguarding health in the tropics.

At a special meeting held on Nov. 16, Dr. Henry Mace Payne, of New York, gave a very interesting lecture on present mining conditions in Mexico, which he illustrated by 50 slides made from photographs taken during his recent trip to the mining regions of southwestern Mexico.

**Mining and Metallurgical Society,** University of Utah, holds a regular meeting from 4 to 6 p.m. on the first Wednesday of each month, at which lectures, pictures and instruction on subjects of interest to the mining fraternity are given. The officers of the society are: C. P. Caulfield, president; Alfred Dunyon, vice-president; Stewart Udell, secretary-treasurer.

**Mining and Metallurgical Association,** Missouri School of Mines, held a meeting in November that was attended by every eligible student in the school. C. H. Fulton, director of the School of Mines, and H. A. Buehler, state geologist and director of the Missouri Bureau of Geology and Mines, addressed the meeting on the subject of the importance of the Institute to the engineer.

**Scientific Society,** Colorado School of Mines, held its first meeting this year on Oct. 5. Addresses were made by Richard A. Parker, Thomas B. Stearns, Robert J. Grant, Frank E. Shepard, F. C. Gilbert, George A. Stahl, L. B. Skinner, V. A. Alderson, I. A. Palmer.

The officers elected for the year are: Theodore Marvin, president; A. C. P. Wong, vice-president; H. Ray Lee, secretary. The executive committee is composed of G. W. Baekeland, R. B. Lowe, H. H. Pratley, A. L. Pierce, L. S. Woeber, J. R. Dorrance, C A. Farlow, J. C. Herron, V. L. Denunzio, H. C. Colony, B. H. Parker, J. Dewey and the officers already named.

A membership campaign conducted under the guidance of Prof. J. C. Roberts, together with the energy developed at the first meeting of the society, has resulted in 90 applications for junior associate membership in the Institute.

A joint meeting with the Colorado Local Section of the Institute is described on page 43.

## Woman's Auxiliary

THE regular monthly meeting of the General Council of the W. A. A. I. M. E. was held on Thursday, Dec. 1, nine members being present.

The president reported the receipt of a copy of the Constitution of the Association of the Women of the Mining Industry of Canada from Mrs. Miller. This organization is the direct outgrowth of the Toronto Section of the W. A. A. I. M. E. Mrs. J. B. Tyrrell, its president, has been a member of our organization since the beginning, and as director of our Toronto Section has been enthusiastic in working out her ideal of an organization that should reach all women in the mining world of Canada. We congratulate Mrs. Tyrrell on the success of her efforts and also upon a well drawn constitution.

Mrs. Dwight, our president, while in Washington in November, had the great pleasure of meeting the members of the Washington Section of the Auxiliary. The following is quoted from the Washington *Star* of Nov. 10, 1921.

One of the most delightful entertainments of last week was the tea given at the Cosmos Club by the Washington Section of the Woman's Auxiliary, American Institute of Mining and Metallurgical Engineers, in honor of Mrs. Arthur S. Dwight of New York, president of the national organization. The society is composed of wives of engineers and scientists and is one of the largest and most important organizations for women in the United States. It has for its primary object the establishment of a fund for the education of young mining engineers, and rendering other service to the profession.

Tea was served in the drawing room of the club. Mrs. H. Foster Bain, wife of the director of the Bureau of Mines, presented the guests. Mrs. H. T. Mulliken, wife of the special technical assistant to the Bureau, presided at the tea table, assisted by Mrs. A. S. Spencer.

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Mrs. Jennings, 2d vice-president, read a most interesting report of her recent trip through the West. In Salt Lake City, she was present at a meeting of the Utah Section of the Auxiliary, at the house of the director, Mrs. R. C. Gemmell; 20 members were present. In this section, each member taxes herself a small amount monthly, which is collected by the treasurer at each meeting, and is used in the work of the section. During the summer, the members made various garments to be distributed to relieve a little of the distress among the unemployed at Bingham.

In San Francisco, on the ninth of November, the following ladies met Mrs. Jennings at luncheon: Mrs. Charles Butters, Mrs. W. J. Crook, Mrs. Charles Janin, Mrs. Edmund Jüssen, Mrs. C. D. Kaeding, Mrs. T. A. Rickard, Mrs. W. H. Shockley. The organization of a section in Northern California is about to be completed.

The monthly luncheon of the New York Section was held at the Wiley's on Wednesday, Nov. 30. There were 49 present. The treasurer reported about $140 as the net proceeds of the card party given for the benefit of the Educational Fund, at Miss Stone's.

Mrs. Dwight read a communication from Mrs Harry Mulliken, secretary of the Washington, D. C., Section, describing the Christmas work being done, in sending books and toys to the children in various mining camps. Mrs. Knox Taylor read an appeal from Payson, Ariz., for books and playthings for children.

Mrs. Brown asked that the work of the Service Committee at the Soldiers and Sailors Club be continued during January, and it was decided that this should be done.

The speaker of the day was Mrs. H. Otto Wittpen, who has been a probation officer in New Jersey for many years and is well qualified to speak on "Delinquent Girls," the subject of her talk. Questions from the members, and a general discussion, followed.

# Government Action of Interest to Engineers

## Extracts from Weekly Bulletin Issued by American Engineering Council

DECEMBER 8, 1921

**New Division in Department of Commerce** to consider simplified commercial practices. It will be a subdivision of the Bureau of Standards. William A. Durgin of the engineering staff of the Commonwealth Edison Co. of Chicago has been granted a leave of absence to assume the direction of the work of the division which will be devoted entirely to the elimination of waste as applied to commercial practices.

**Annual Report of Commissioner of Patents** for the fiscal year ending June 30, 1921 shows an increase of 34 per cent. in the number of applications and an increase of 85½ per cent. in trade-mark applications. There were at the end of the fiscal year 49,334 patents awaiting action out of a total number of applications of 84,248. It also showed that the office had lost 163 scientifically and legally trained examiners, some of whom have been replaced by inexperienced men.

DECEMBER 1, 1921

**Federal Power Commission** at its next meeting will consider the much controverted "high dam" project on the Mississippi at St. Paul and Minneapolis. While it is fairly evident that the Northern State Power Co. can make most complete use of this project, which has considerable secondary power, its efforts are being actively opposed by Senator Nelson who claims that the company is a monopoly.

**Coal Industry and the Government.**—An effort is being made to work out a standardized contract to be used by the Government in the purchase of coal. The work on behalf of the coal men is being directed by George Reed of the Peabody Coal Company, Chicago, and F. R. Wadleigh for the Government.

NOVEMBER 23, 1921

**New Power Plants.**—The Geological Survey recently issued a map of New York showing the location of power stations and electric transmission lines used by the public utility companies. The map of Pennsylvania is now ready for distribution and maps covering New Hampshire and Vermont are nearing completion. Other maps in the super-power zone are being prepared in collaboration with the power companies.

**Mineral Industry.**—Two new pictures are ready for distribution from the Pittsburgh office of the Bureau of Mines. The first covers "The Story of Heavy Excavating Machinery," showing types of steam, gasoline, electric shovels and other heavy excavating apparatus used in mining operations. The subject of the second picture is "Mexico and Its Oil." It shows the technical operations of petroleum production in the great oil fields of Mexico.

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## Investigations by the Bureau of Mines*

**Determination of Oxides of Nitrogen** (Technical Paper 249). By A. C. Allison, W. L. Parker, and G. W. Jones.—Describes a new method for the determination of this noxious gas, sometimes formed after blasting in metal mines.

**Oil-camp Sanitation** (Technical Paper 261). By C. P. Bowie.—Recommends remedial measures for faulty sanitation in oil camps. In the average mushroom community, sanitary conditions are so imperfect as practically to invite the visitation of a costly fire or epidemic. Many oil men employ the contract system of drilling, which almost eliminates the tendency of companies to build camps or small towns over which they may exercise personal supervision as to housing and sanitation.

The responsibility for the betterment of such conditions plainly belongs to the state governments; broadly speaking, all the states have legislation adequate to cope with these exigencies. The neglect of those in authority to meet these responsibilities brings hardship and unnecessary misery to a class of migratory workers who may be especially susceptible to the influence of social unrest.

In the older oil fields, although sanitary conditions are seldom all that can be desired, they are much superior to conditions in the new oil fields of less populated districts.

**Recovery of Unburned Fuel from Boiler-furnace Refuse** (Serial No. 2281). By Thomas Fraser and H. F. Yancey.—About 24 per cent. of our total production of bituminous coal is used in industrial power plants. As regards fuel conservation, therefore, the recovery of unburned fuel from furnace refuse presents interesting possibilities.

# Increase of Membership Department

**Total membership as of Dec. 17, 1921, is 10,329**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period Nov. 20 to Dec. 17, 1921, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

### Members

**1—Francisco Alayza y Paz Soldan,** Miraflores, Lima, Peru, S. A.
Present position: Director of the School of Arts and Trades of Lima.
Proposers: Fernando C. Fuchs, José Balta, José J. Bravo.

**2—Oliver Henry Bell,** Ely, Minn.
Present position—1920 to date: Chief Engineer, Vermillion Mining Company.
Proposers: Kenneth Duncan, William A. Rose, John C. Metcalf.

**3—Louis Burgess,** Elizabeth, N. J.
Present position: Chemist in charge of a Division of Research for the Standard Oil Co. (N. J.).
Proposers: Maurice Barnett, Frank H. Ramsey, Donald M. Liddell.

**4—Frank Carney,** Wichita, Kansas.
Present position—1917 to date: Chief Geologist, National Refining Co., Cleveland, Ohio.
Proposers: R. S. Hazeltine, Herman J. Allen, Marvin Lee.

**5—Cecil Reginald Clark,** Trinidad, B. W. I.
Present position—1919 to date: General Manager for British Controlled Oil Fields, Ltd.
Proposers: George B. Reynolds, E. K. Soper, L. L. Foley.

**6—Wilbur Ray Cusac,** Detroit, Mich.
Present position—1917 to date: Assistant Metallurgical Engineer, Dodge Brothers.
Proposers: M. H. Schmid, C. T. Bragg, M. T. Lothrop.

**7—Gustav Egloff,** Chicago, Ill.
Present position: Technical Director, Universal Oil Products Co.
Proposers: W. A. Williams, Van H. Manning, C. B. Dutton.

**8—John T. Fetherston,** Cuylerville, N. Y.
Present position: Manager, Sterling Salt Co.
Proposers: R. V. Norris, Edward W. Brown, Charles H. Snow.

**9—Charles David Heaton,** Egnar, Colo.
Present position—1912 to date: Superintendent, American Rare Metals Co.
Proposers: C. Montague Butler, W. H. Staver, Charles L. Harrington.

**10—Wilmot Carlyle Jones,** Freeland, Pa.
Present position: Mining Engineer, Wentz Co., Hazelton, Pa.
Proposers: T. E. Snyder, E. P. Humphrey, B. C. Osler.

**11—Carl Edward Mills,** Jerome, Ariz.
Present position—1920 to date: Chief Mining Engineer, United Verde Copper Co.
Proposers: Louis E. Reber, Jr., W. V. De Camp, H. De Witt Smith.

*Reports in full may be obtained from the Director of Bureau of Mines, Washington, D. C. Give serial number.

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**12—Frank Pardee,** Hazleton, Pa.
Present position: President, Anthracite Separator Co.; Vice-President, Hazleton National Bank.
Proposers: I. P. Pardee, J. B. Warriner, Edwin Ludlow.

**13—Gordon Cecil Priddey,** Smethwick, Birmingham, England.
Present position—1914 to date: Chief Assistant Chemist, Works Manager, Chemist and Metallurgist, Henry Wiggin & Co., Ltd.
Proposers: H. M. Ridge, Ernest R. Woakes, Henry F. Collins.

**14—George A. Roos,** Pottsville, Pa.
Present position—1917 to date: Division Engineer, Philadelphia & Reading Coal & Iron Co., St. Clair Division.
Proposers: D. C. Ashmead, W. A. Richards, F. E. Powers.

**15—James W. Schwab,** Gulf, Matagorda Co., Tex.
Present position—1920 to date: Chemist, Texas Gulf Sulphur Co.
Proposers: Charles Biesel, H. E. Treichler, Walter H. Aldridge.

**16—Frank J. Smith,** Stambaugh, Mich.
Present position—1912 to date: Superintendent, Brule Mining Co.
Proposers: E. Leslie Laing, Rudolph Ericson, E. W. Hopkins.

**17—Lucien W. Smith,** Littleton, Colo.
Present position—1910 to date: Superintendent, Mt. Champin Mining Co.
Proposers: Frank E. Shepard, Robert W. Gordon, Horace F. Lunt.

**18—Beveridge Stead,** Paterson, N. J.
Present position: Not Engaged.
Proposers: F. H. Hayes, E. F. McCrossin, C. M. Staples.

**19—Emilio Alves Teixeira,** Passos, Minas, Brazil, S. A.
Present position: Topographic Surveyor in Passos County.
Proposers: H. H. Stoek, E. A. Holbrook, W. H. Staver.

**20—John Thomas Watson,** Eckman, W. Va.
Present position—1920 to date: Chief Engineer, Pulaski Iron Company.
Proposers: Floyd E. Cunningham, John J. Lincoln, R. A. Nowlin.

**21—Kentaro Yoshizawa,** New York, N. Y.
Present position—1920 to date: Chief Mining Engineer, Mitsui Mining Co.
Proposers: Kagakushi, T. Dan, Charles E. Locke, Robert H. Richards.

### Associates

**22—Edmund Carter Berkeley,** Van, W. Va.
Present position—1920 to date: Superintendent, Y. & O. Co.
Proposers: H. B. Turner, Ernest M. Merrill, Carl Scholz.

**23—Edward John Paul Fisher,** Worcester, Mass.
Present position: Metallurgist, Atlas Die-Casting Co.
Proposers: George R. Ensminger, William Campbell, Roysel J. Cowan.

**24—Wallace W. Fowler,** La Fundicion, Peru, S. A.
Present position: Chemist, Cerro de Pasco Copper Corporation.
Proposers: C. L. Baker, S. Sellner, Redick R. Moore.

**25—Wentworth Harrington Osgood,** Pittsburgh, Pa.
Present position—1912 to date: On Active Duty, U. S. Navy.
Proposers: L. G. Huntley, Roswell H. Johnson, R. E. Somers.

**26—Jens Christian Petersen,** Cerro de Pasco, Peru, S. A.
Present position: Assistant Superintendent, Cerro de Pasco Brick Plants.
Proposers: L. S. Breckon, M. R. Cuthbertson, John K. Walsh.

**27—John Barclay Rhodes,** Philadelphia, Pa.
Present position: Executive Officer, U. S. S. Huron.
Proposers: C. E. Margerum, John E. Arthur, 3rd, Charles R. Fair.

**28—Mark Howard Secrist,** Baltimore, Md.
Present position—1919 to date: Graduate student in geology, Johns Hopkins University.
Proposers: Edward B. Mathews, Joseph T. Singewald, Jr., W. Armstrong Price.

### Junior Associates

**29—Everett Philip Andrews,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**30—Paul Wesley Banks,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**31—Morris K. Barrett,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**32—William Earl Clark,** Columbus, Ohio.
Student, Ohio State University.
Proposers: H. E. Nold, William A. Mueller, William J. McCaughey.

**33—Tristram Coffin Colcord,** Morgantown, W. Va.
Student, West Virginia University.
Proposers: A. C. Callen, David B Roger, I. C. White.

**34—Arthur Presely Davidson,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**35—Ray Jackson Farmer,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: I. A. Palmer, J. C. Roberts, Victor C. Alderson.

**36—Joseph Lee Fearing,** Cambridge, Mass.
Student, Harvard Engineering School.
Proposers: Alfred Wandke, George S. Raymer, L. C. Graton.

**37—James M. Fergotson,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: M. H. Thornberry, Charles Y. Clayton, C. R. Forbes.

**38—Jack E. Fyfe,** Socorro, N. M.
Student, New Mexico State School of Mines.
Proposers: T. W. Quayle, W. G. Ramlow, B. H. Kinney.

**39—Chester Merle Gardiner,** Berkeley, Cal.
Student, University of California.
Proposers: Frank H. Probert, Lester C. Uren, Ernest A. Hersam.

**40—Charles Allen Gibbons,** Morgantown, W. Va.
Student, West Virginia University.
Proposers: A. C. Callen, David B. Reger, I. C. White.

**41—Joseph John Haberthier,** Rolla, Mo.
Student, Missouri School of Mines and Metallurgy.
Proposers: C. R. Forbes, Joseph R. Guiteras, C. L. Dake.

**42—Walter Joseph Heiler,** Pittsburgh, Pa.
Student, Carnegie Institute of Technology.
Proposers: Fred. Crabtree, Charles R. Fettke, R. Z. Virgin.

**43—Lawrence Carl Keeley,** Madison, Wis.
Student, University of Wisconsin.
Proposers: Clifton S. Corbett, A. N. Winchell, W. J. Mead.

**44—Edward A. Kilinski,** New York, N. Y.
Graduate student, Columbia University.
Proposers: James F. Kemp, Charles P. Berkey, R. J. Colony.

**45—Edgar DeWitt Klinger,** State College, Pa.
Student, Pennsylvania State College.
Proposers: William R. Chedsey, C. A. Bonine, E. S. Moore.

**46—Ben McColloch Layton,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, C. L. Dake, J. R. Guiteras.

**47—Howard Chapin Lewis,** Appleton, Wis.
Student, Lawrence College.
Proposers: Rufus M. Bagg, Richard S. McCaffery, Thomas W. Orbison.

**48—Earl Hollinger McAlpine,** Rolla, Mo.
Student, Missouri School of Mines and Metallurgy.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**49—Fulton Young Magill,** Tacoma, Wash.
Student, University of Washington.
Proposers: Milnor Roberts, Joseph Daniels, C. R. Corey.

**50—John Fuller Malony,** Stanford University, Cal.
Student, Stanford University.
Proposers: W. F. Dietrich, Theodore J. Hoover, Bailey Willis.

**51—James Rea Maxwell, Jr.,** Cambridge, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Carle R. Hayward, H. O. Hofman, W. Lindgren.

**52—Casper Alexander Michelson,** Salt Lake City, Utah.
Student, University of Utah.
Proposers: Robert H. Bradford, Frederick J. Pack, James T. Norton.

**53—Walter Scott Moore,** Morgantown, W. Va.
Student, West Virginia University.
Proposers: A. C. Callen, David B. Reger, I. C. White.

**54—Charles Clifford Mosena,** Rolla. Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, C. L. Dake, C. R. Forbes.

**55—Albert J. Phillips,** New Haven, Conn.
Student, Sheffield Scientific School.
Proposers: C. H Mathewson, R. K. Warner, Arthur Phillips.

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**56—Jack Cooley Pratt**, Houghton, Mich.
Student, Michigan College of Mines.
Proposers: J. B. Cunningham, Richard V. Ageton, Guy E. Ingersoll.

**57—Pierre Rondon**, Socorro, N. M.
Student, New Mexico State School of Mines.
Proposers: T. W. Quayle, W. G. Ramlow, B. H. Kinney.

**58—James W. Stewart**, Morgantown, W. Va.
Student, West Virginia University.
Proposers: A. C. Callen, David B. Reger, I. C. White.

**59—Milo Whitney Summers**, Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, G. A. Roush.

**60—Evan Gwynne Thompson**, Madison, Wis.
Student, University of Wisconsin.
Proposers: Clifton S. Corbett, W. J. Mead, A. N. Winchell.

**61—Frederick Francis Truebger**, Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**62—Herman Frederick Valentine**, Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, C. R. Forbes, Joseph R. Guiteras.

**63—Everett John Wendell**, Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

Change of Status—Associate to Member

**64—Roscoe Everett Shutt**, Mexico, D. F., Mexico.
Geologist, Standard Oil Co. of California.

**65—Henry Tackmann**, Rosiclare, Ill.
Present position: Engineer, Fairview Fluorspar & Lead Co.
Proposers: W. C. Bohn, Lincoln A. Stewart., E. C. Reeder.

Change of Status—Junior Associate to Member

**66—Ulysses Henry Berthier**, Monterrey, N. L., Mexico.
Present position—1920 to date: Refinery Superintendent, Monterrey Smelter, Cia. Minera de Penoles, S. A.

**67—Harold Lippert Rau**, Milwaukee, Wis.
Present position—1920 to date: Field Oil Geologist, Lower fields, Mexico, with Cia. Mexicana de Petroleo, "El Aguila" S. A., Tampico, Mexico.

Change of Status—Junior Associate to Associate

**68—Harvey Hardison**, Coalinga, Cal.
Present position: Geologist, Associated Oil Co.
Proposers: Frank H. Probert, Ernest A. Hersam, Lester C. Uren.

## Do You Know Where These Men Are?

| Name | Last Address of Record from which Mail Has Been Returned |
|---|---|
| Abadie, Emile | Blue Mountain Gold Mine, Woody, Cal. |
| Alsdorf, F. C. | Inn Hotel, Shreveport, La. |
| Appleton, John R. | Colorado School of Mines, Golden, Colo. |
| Block, James A. | Resident Engr., Thacker Fuel Co., New Thacker, W. Va. |
| Blow, John J. | 404 High Holborn, London, W. C., England. |
| Bradley, D. H., Jr. | Box 93, Prescott, Ariz. |
| Buchanan, W. A. | Mgr., Meteor Mine, Slocan City, B. C., Canada. |
| Carlson, A. E. | 412 Sellers St., Hibbing, Minn. |
| Carns, Foss D. | Arizona Binghamton Copper Co., Stoddard, Ariz. |
| Chang, Ko Chi | Student, Carnegie Inst. of Tech., Pittsburgh, Pa. |
| Chatin, August H. | 3832 Umatilla St., Denver, Colo. |
| Chu, S. Y. | Columbia Univ., New York, N. Y. |
| Claghorn, D. Montgomery | care C. R. Claghorn, Claghorn, Indiana Co., Pa. |
| Claghorn, James L. | care C. R. Claghorn, Claghorn, Indiana Co., Pa. |
| Cleland, George A. | Miazza Woods Bldg., Meriden, Miss. |
| Crawford, T. R. | Box 806, Butte, Mont. |
| Crocker, A. L. | 601 North West Bank Bldg., Minneapolis, Minn. |
| Davis, John N. | Supt. of Mills, Engels Copper Min. Co., Engelmine, Plumas Co., Cal. |
| Duga, Joseph B. | Asst. Chief Chem., Mid-Continent Iron Co., Midco, Carter Co., Mo. |
| Duncan, L. Grant | Depue, Ill. |
| Ford, Allen P. | Crane Co., Bridgeport, Conn. |
| Fowles, Charles | Durango Min., Mill. & Exploration Co., Box 99, Hachita, New Mexico. |
| Gerber, C. O. | Missouri School of Mines, Rolla, Mo. |
| Granger, Henry G. | Cartagena, Colombia. |
| Granting, Hugo G. | Box 966, Warren, Ariz. |
| Gray, John N. D. | 1857 Cahuenga Ave., Hollywood, Cal. |
| Grebe, Emil | Phoenix, Ariz. |
| Greit, Adolph J. | San Miguel 207, Havana, Cuba. |
| Hasbrouck, Bernard | Cortez Oil Co., Tampico, Mexico. |
| Hatfield, Percy W. | 3312 Woolworth Bldg., New York, N. Y. |
| Hill, Benjamin F. | 302 N. 4th St., Cripple Creek, Colo. |
| Hindshaw, H. H. | 617 Forest Ave., Ann Arbor, Mich. |
| Hoaas, Ole G. | 1644 Taylor St., San Francisco, Cal. |
| Hognason, Guy B. | Phoenix, Ariz. |
| Jones, Wendell T. | Apt. 3, 925 Pierce St., San Francisco, Cal. |
| Kaufman, E. C. | Federal Metal Co., 6621 Morgan Ave., Cleveland, O. |
| Krohn, Arthur | 1475 Leland Ave., Chicago, Ill. |
| Konselman, Albert S. | Compania General de Inversiones Minerals, S. A., Pachuca, Hgo., Mexico. |
| Lewyn, Oswald M. | Guggenheim Bros., New York, N. Y. |
| Li, Chu | Student, Columbia Univ., New York, N. Y. |
| Lyons, Clyde Francis | Box 18, Tyrone, N. M. |
| McMillen, Frank M. | Missouri School of Mines, Rolla, Mo. |
| McVey, Earle Yancey | Genl. Supt., Mine Office, Coal Beth Coal Co., Bentree, W. Va. |
| Mackay, Angus | 951 O'Farrell St., San Francisco, Cal. |
| March, Harry | Councillor, Midland Institute of Min. Engrs., 17 Victoria St., Westminster, London, S. W., England. |
| Marston, Robert L. | Carter Oil Co., Tulsa, Okla. |
| Mennie, Thomas S. | M. & O. Specialty Mfg. Co., Room 4, 105 Gratiot Ave., Detroit, Mich. |
| Meyer, Ralph A. | Mizpah Hotel, Tonopah, Nev. |
| Moraes, Jose E. A. | Student, Colorado School of Mines, Box 31, Golden, Colo. |
| Morgan, D. M. | 407 W. 4th St., Joplin, Mo. |
| Murray, Henry T. | 3707 Oxford St., El Paso, Texas. |
| Nieman, Henry W. | 27 West 44th St., New York, N. Y. |
| Noble, Clarke O. | 120 S. Walker St., Albuquerque, N. M. |
| Nugent, William E. | Colorado School of Mines, Golden, Colo. |
| Pelton, Harold A. | Camp Lewis, Wash. |
| Perry, Ralph G. | Southern Illinois Engrg. Co., Herrin, Ill. |
| Ponton, G. M. | Westbrook Hotel, Fort Worth, Tex. |
| Putsch, August | care F. O. Dettmann, 29 Broadway, New York, N. Y. |
| Ray, Otto A. | Univ. of Wisconsin, Madison, Wis. |
| Rossi, Carlo | Dr. of Chem., Board Director Officine Elettrochimiche, Legnano, Milan, Italy. |
| Rutlidge, Charles S. | Britannia Min. Co., Inc., Cuba 71, Habana, Cuba. |
| Schuler, Herman | Director, Agna Amarga Copper Co., Ltd., Vallenar, Chile, South America. |
| Seagrave, W. H. | Seattle, Wash. |
| Shayes, Fred P. | Roxana Petroleum Corpn., Covington, Okla. |
| Shih, Hsin Pu | Box 449, Rolla, Mo. |
| Smith, Richard Raymond | Foreman, Moctezuma Copper Co., Pilares de Nacozari, Sonora, Mexico. |
| Starr, Charles C. | Supt., Tonopah Divide Mine, Tonopah, Nev. |
| Tao, H. T. | Michigan College of Mines, Houghton, Mich. |
| Thomas, W. E. | Cia Minerales y Metales, S. A., Apt. 251, Monterrey, N. L., Mexico. |
| Thurmond, F. LeRoi | Swansea Lease, Inc., Swansea, Ariz. |
| Trebilcock, John Perry | Min. Supt., Big Ledge Copper Co., Huron, Ariz. |
| Tsen, B. C. | Care Mrs. Cindburg, Sewaren, N. J. |
| Tuck, Douglas | Los Angeles, Cal. |
| Ude, G. Edgar | Box 933, Morenci, Ariz. |
| Van Horn, Frank B. | 1636 So. Baltimore St., Tulsa, Okla. |
| O'Neal, Frank E. | Gouleg Mountain Coal Co., Jodie, W. Va. |
| Vahrenkamp, Frederick H. | Fred H. Vahrenkamp & Co., 675–677 Monadnock Bldg., San Francisco, Cal. |
| Watson, Hugh C. | Michigan-Colorado Min. Co., Bedrock, Colo. |
| Watts, Blythe, D. | Sec., Lynite Laboratories, Cleveland, O. |
| White, C. K. | Latouche, Alaska. |
| Whyte, W. de Burgh | 901 Lexington Ave., New York, N. Y. |
| Willey, Howard | Magma Copper Co., Superior, Ariz. |
| Williams, Daniel J. | Mgr., Continental Development Co., Skeena Crossing, B. C., Canada. |
| Womble, Lloyd A. | Union Miniere du Haut Katanga, Elisabethville, Congo Belge, So. Africa. |
| Wong, Yin Charles | 414 W. 118th St., New York, N. Y. |
| Youtz, Ralph C. | Calumet & Arizona Min. Co., Bisbee, Ariz. |

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# Engineering Societies Library

HARRISON W. CRAVER, Director

## Book Review

**Mine Accounting and Cost Principles.** By T. O. McGrath. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 257 pp., tables, 9×6 in., cloth, $4.

This book by the auditor for the Shattuck-Arizona copper Co. is quite different from any other of the many books on mine accounting. After a statement of general principles it begins with the original money that may be put up for the purchase of a mine, say in the East where most of such money is raised, and goes through the operation of issuing stock, opening stock ledgers, etc., and a set of administrative books for the eastern office.

It takes the reader through the payment for the property, through a set of books and accounts during the development period of the mine and performs all the bookkeeping and accounting operations required when the mine goes from a developing to a producing basis. It takes up all the complicated details of bookkeeping and accounting for the mine product as it goes to the mill or smelter, some metallurgical bookkeeping, and the still more complicated accounts required in the final sale of the product, the example given being copper. It disposes of the sales receipts to dividends, capital return, surplus, etc., and returns operating money to the mines.

This book has the following advantages:

1. It covers the entire business of a mining accounting system from start to finish.
2. It treats the matter in narrative, or lecture form, which gives a continuity to the subject that not only adds to its clarity but robs it of its normally inherent dryness.
3. It not only tells what to do, but by example and specific entries shows how it is done.
4. It deals with the very complex subjects of depletion and depreciation as required by the new Income Tax Laws and shows how the corresponding accounts should be handled.
5. It is a book for both the accountant and the bookkeeper.
6. It has many bookkeeper's helps which make for office efficiency as well as accounting efficiency.
7. It shows how to compile, distribute and report mine operating costs, which is a most difficult problem.

P. E. B.

## Book Notices

**Annals of American Academy of Political and Social Science.** May, 1920. Vol. 89, No. 178. 289 pp., 9 × 6 in., paper. $1.25.

Essays by well-known economists, business men and engineers, discussing economic significance of present day prices, price factors in typical commodities, wages, profits and excess profits taxes, production, coöperation, international finance and trade in their relation to prices, inflation and prices, and world's monetary problems.

**Bleaching.** By S. H. Higgins. Manchester, University Press; Lond. and N. Y., Longmans, Green & Co., 1921. 137 pp., 9 × 6 in., cloth, $3.75.

Important researches of recent years discussed as a basis for further research. Book is intended to be a supplement to other books dealing with this industry.

**Central Station Rates in Theory and Practice.** By H. E. Eisenmenger. Chicago, Frederick J. Drake & Co., 1921. 382 pp., illus., 7 × 5 in., fabrikoid.

Textbook for students of electric rates, for beginners as well as experts. Discusses cost of electric service, its price, systems of charging, rate analysis, accuracy of rates and regulation of public utilities. Appeared serially in *Electrical Review*.

**Centrifugal Pumps.** By J. W. Cameron. Lond., Scott, Greenwood & Son, 1921. 142 pp., illus., 9 × 6 in., cloth, $3.75. (Gift of D. Van Nostrand Co.)

Discusses theory of these pumps, hydraulic losses, hydraulic efficiency, bearings, effect of vane angle on efficiency, pump details, axial thrust balancing, calculation and design of pumps, and commercial types. For engineers and draftsmen.

**Chemical Disinfection and Sterilization.** By Samuel Rideal and E. K. Rideal. Lond., Edward Arnold & Co., 1921. 313 pp., 9 × 6 in., cloth, $7.50. (Gift of Longmans, Green and Co.)

Summarizes some of the more important applications of general methods for sterilization of food, air and water, for public and private disinfection, for extirpating non-bacterial parasites and for preserving wood. Describes chemicals employed in disinfection, and methods for their analysis and testing. Contains numerous bibliographies.

**Chemical Warfare.** By Amos A. Fries and Clarence J. West. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 445 pp., illus., 8 × 6 in., cloth, $3.50.

History of the Chemical Warfare Service of the Army during the World War; intended also as a textbook for the Army, the reserve officer and the chemist.

**Coal, Oil, Gas, Limestone, and Iron Ore Map.**—West Virginia Geological Survey, Box 848, Morgantown, West Va. Scale, 8 miles to the inch. Price, folded in strong envelope and delivered by mail, $1; 6 copies for $5.

Thoroughly revised, showing oil and gas pools, many anticlinal lines not heretofore shown, with booklet giving names and addresses of principal coal-mining operators in West Virginia up to July 1, 1921.

**Coke-oven and By-product Works Chemistry.** By Thos. Biddulph-Smith. Lond., Charles Griffin & Co., Ltd.; Phila., J. B. Lippincott Co., 1921. 180 pp., illus., plates, 9 × 6 in., cloth, $7.

Concise manual of methods of chemical analysis covering general work required for chemical control of by-product coking plants, for works managers and chemists. An appendix gives a general survey of substances obtainable by distilling coal tar.

**Condensed Catalogues of Mechanical Equipment.** American Society of Mechanical Engineers. Eleventh annual volume, Oct., 1921. 932 pp., illus., 9 × 6 in., cloth, $4.

Four thousand firms are listed, under 3000 classes; 495 have data about their products in the book. One thousand consulting engineers are classified under 400 lines of specialization.

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**Combustibles Liquides et Leurs Applications.** Syndicat d'Applications Industrielles des Combustibles Liquides. Paris, Gauthier-Villars et Cie, 1921. 621 pp., illus., 6 × 4 in., cloth.

Gives regulations governing importation and use of liquid fuels, insurance laws, brief descriptions of chief oil-producing countries, principal fuel oils and lubricants and methods for testing them. Describes leading French types of internal combustion engines, furnaces and boilers and gives directions for storing and shipping oil. Contains conversion tables and coefficients.

**Diagnosing of Troubles in Electrical Machines.** By Miles Walker. Lond. and N. Y., Longmans, Green and Co., 1921. 450 pp., diagrs., 10 × 7 in., cloth, $10.50.

Discusses troubles due to defective insulation, over-heating, low efficiency, and those peculiar to alternating and direct-current generators and motors, synchronous converters, motor generators and induction motors. Especially concerned with troubles in the field, not with factory tests.

**Early Science in Oxford.** Part 1. Chemistry. By R. T. Gunther. Lond., Hazell, Watson and Viney, Ltd., 1920. 91 pp., illus., plates, 8 × 6 in., paper, $3.50. (Gift of Oxford University Press, American Branch.)

Traces the story from its beginning with Roger Bacon in 1214 down to the early nineteenth century.

**Electrons and Ether Waves.** Twenty-third Robert Boyle Lecture. By Sir William Bragg. Lond. and N. Y., Oxford University Press, 1921. 14 pp., 9 × 6 in., paper. $0.45.

Discusses connection between ether waves and electrons and relation between wave length of ether radiations and velocity of ejected electrons. Gives a non-mathematical account of present information.

**Elektrische Fördermaschinen.** By W. Philippi. Leipzig, S. Hirzel, 1921. 304 pp., illus., 9 × 6 in., paper.

Use of electric hoisting machinery in mining is covered from several viewpoints, mechanical, electrical and economic, with special stress upon the last aspect of the question.

**Éléments d'Analyse Mathématique.** By Paul Appell. 4th edition. Paris, Gauthier-Villars et Cie, 1921. 715 pp., 10 × 7 in., paper. 65 fr.

Textbook of elements of mathematical analysis for engineers and physicists. Particular attention is given to use of analysis in geometry, physics and mechanics. All theories are illustrated by application to particular cases.

**Employment Management, Wage Systems and Rate Setting.** First edition. N. Y., The Industrial Press, 1921. 103 pp., 9 × 6 in., paper. $1.

Concise description of systematic methods of employing and placing men, and of wage payment systems, based on articles that have appeared in *Machinery*.

**Die Förderung von Massengütern.** By George von Hanffstengel. Vol. 1. Berlin, Julius Springer, 1921. 306 pp., illus., 9 × 6 in., cloth. 234M.

Deals with belt, chain, bucket, screw, spiral, pneumatic and hydraulic conveyors. Covers modern practice very thoroughly. Has been thoroughly revised for third edition.

**Foundations of Chemical Theory.** By R. M. Caven. N. Y., D. Van Nostrand Co., 1921. 266 pp., diagrs., 9 × 6 in., cloth, $4.

An account of the meaning of modern chemistry without multitudinous facts, for the student and general reader.

**Graphical Methods.** By William C. Marshall. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 253 pp., charts, 9 × 6 in., cloth. $3.

Treatise on construction and use of graphical charts. Gives examples of application of charts to many purposes and contains an extensive bibliography of published charts.

**Handbook for Field Geologists.** By C. W. Hayes. Third edition, revised and rearranged by Sidney Paige. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 166 pp., illus., 7 × 5 in., fabrikoid. $2.50.

Pocket size manual giving summary of methods and instruments most useful in field work, with outlines and schedules covering investigations in the several fields of geology. Contains an appendix on mineralogy.

**Invention the Master-key to Progress.** By Bradley A. Fiske. N. Y., E. P. Dutton & Co., 1921. 356 pp., illus., 8 × 6 in., cloth. $4.

An interesting account of what inventors have accomplished through the ages, and a forecast of what may be done in the future, if the art of invention is properly fostered.

**Manual of Determinative Mineralogy.** By Charles H. Warren. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 163 pp., 7 × 5 in., fabrikoid. $2.

To supplement descriptive text and crystallography. Represents course given in Massachusetts Institute of Technology.

**Mechanical Handling of Goods.** By C. H. Woodfield. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. (Technical primers.) 116 pp., illus., 6 × 4 in., cloth, $0.85.

To enable the unitiated to understand methods and equipment employed and appreciate economic possibilities of dealing with goods by mechanical methods.

**Mining Physics and Chemistry.** By J. W. Whitaker. Lond., Edward Arnold & Co., 1921. 268 pp., diagrs., tables, 7 × 5 in., cloth. $3. (Gift of Longmans, Green & Co.)

Introductory textbook giving knowledge needed by underground miner or official, particularly in collieries. Ventilation, spontaneous ignition, explosions and explosives, waters, mine gases, etc. are treated in simple language.

**Oil-field Practice.** By Dorsey Hager. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 310 pp., illus., diagrs., 7 × 5 in., fabrikoid. $3.

Subjects treated are acquisition of lands, development drilling, development production methods, transportation, storage, fires, avoidable wastes and losses, refining methods, valuation and buying, etc. Appendix contains sample forms for records, useful tables and a glossary. The book presents American methods. To a certain extent it supplements the author's earlier work, "Practical Oil Geology."

**Physical Properties of Colloidal Solutions.** By E. F. Burton. Second edition. Lond. and N. Y., Longmans, Green and Co., 1921. (Monographs in physics.) 221 pp., illus., 9 × 6 in., cloth. $4.25.

Outline of study of colloidal solutions particularly their relation to development of physics. Extended description is given of development of the ultra-microscope and confirmation of the kinetic theory of matter by the Brownian movement.

**Profit Sharing by American Employers.** Report of Profit Sharing Department of National Civic Federation. N. Y., E. P. Dutton & Co., 1921. 416 pp., 8 × 5 in., cloth. $8.

The first edition, published in 1916, was based on analyses of more than 200 plans for profit-sharing in use in this country. This edition is practically a new book; much of the former material has been omitted and numerous additions have been made, bringing it up to 1919.

**Railway-signaling.** By Everett Edgar King. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 371 pp., illus., diagrs., 9 × 6 in., cloth, $4.

Common practice in railway signalling presented in text-book

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form, for beginners. Book discusses signal indications, interlocking, block signaling, signal mechanisms and highway crossing signals.

**Special Libraries Directory.** Edited by Dorsey W. Hyde, Jr. Wash., Special Libraries Association, 1921. 123 pp., 9 × 6 in., paper. $2.

Comprehensive survey of specialized collections of literature upon various subjects in the United States. Over 1300 libraries belonging to universities, societies, business houses and other agencies are listed by subject and also geographically. Valuable to research students, in indicating sources of information.

**Steam Engine Valves and Valve Gears.** By E. L. Ahrons. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. (Technical primers.) 112 pp., illus., 6 × 4 in., cloth, $0.85.

Concise description of usual forms of steam engine valves and valve gears, and an explanation of their action.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices recieved before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau for one month.

Positions of the Bureau are on file in the offices of the member societies of the Federated American Engineering Societies and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Petroleum Geologist.**—Graduate. Two years in Mexico in charge of field parties for oil company. Speaks Spanish fluently. Age 26. Single. Engaged in Eastern states but wishes to return to foreign work. New York or Pittsburgh interview. IM-1519.

**Mining Engineer.**—Technical graduate. Seven years practical experience. Speaks Spanish. Age 31. IM-1520.

**Metallurgical Engineer.**—Graduate. Successful research and operating experience in iron and steel and non-ferrous alloys. IM-1521.

**Engineer.**—Member A. S. C. E. & A. I. M. E. with office in New York city desires to act as engineering, purchasing, or sales representative whole or part time, fee or commission basis. IM-1522.

**Mining Engineer.**—Graduate 1916. Experienced mine foreman in Wisconsin, Kansas, Oklahoma zinc fields. Engineer for large copper company. Speaks some Spanish and French. Prefers foreign appointment. IM-1523.

**Mining Engineer.**—Technical graduate. Seventeen years management, development and examination of mines in United States, Mexico and South America. Prefer New York headquarters, but would live elsewhere. Willing to go on trips. Available in New York City. IM-1524.

**Manager or General Superintendent.**—Fifteen years developing mines and in construction of large plants. Would consider foreign engagement with large company. Age 38. IM-1525.

## Positions Open

**Transmission Line Superintendent.**—Must be conversant with practice in transmission lines, 100,000 volt, three phase, 50 cycle. Capable of taking entire charge of transmission system of approximately 400 miles of lines; familiar with construction and operating work, and capable of handling native help. Reply stating age, experience, training and salary desired. India. X-1292.

**Engineer** to take charge of electrolytic silver refinery. Apply by letter only. Must have experience in this work. Mass. X-1314.

**Engineer** acquainted with Zaragosa Columbia territory and able to make careful test and ore map of 28 mines, including placers of about 5000 acres and quarts mines. Small investment necessary. X-1432.

**Chemical Engineer.**—Must have actual experience in production of hydrogen peroxide in large quantities and be able to take full charge of operations, including analytical determinations, processing, plant equipment, purchase of materials, and shipments. New Jersey. X-1437.

**General Superintendent** for foundry, coreshop, machine shop and pattern department. Must be experienced in shop organizing, efficient operation, and familiar with methods of securing maximum production. Pennsylvania. X-1448.

**Metallurgical Engineer.**—Expert in electrolytic partition of gold and silver. Apply by letter. Only engineers with this experience will be considered. South America. X-1449.

**Salesman** experienced in electric-arc welding and welding repair work. Apply by letter, stating age, education and welding experience. X-1455.

**Foundry Executive.**—To take charge of medium size foundry manufacturing plumbing supplies, etc. Must be capable office manager, understand cost accounting, payroll work, and have sales experience. Kansas. X-1458.

**Draftsman for Structural Steel.**—Single man preferred. Position may not prove permanent, on account of unsettled condition of copper camps. Arizona. X-1472.

**Young Man** experienced in brass manufacturing as assistant superintendent in a foreign country. Give concise record of experience, qualifications and salary expected. X-1474.

**Salesmen.**—Two technical men who have had underground metal-mining experience. Between 25 and 35 years old. Headquarters Butte, Mont. and Phoenix, Aris. X-1475.

**Engineer** with practical converter experience in metallurgy of copper. Apply by letter, stating age, education and experience. X-1529.

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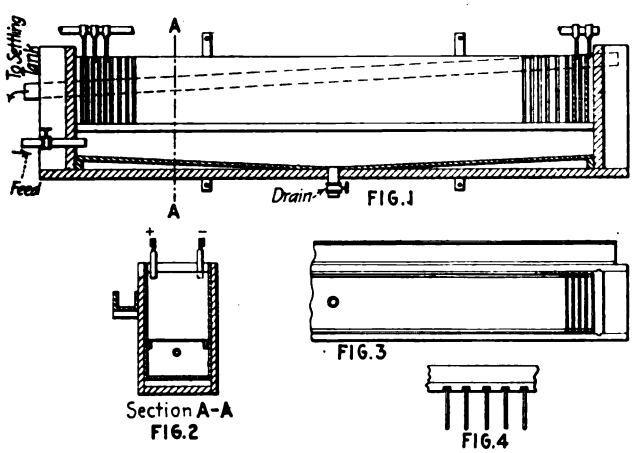
# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

## Stimulation of Free Settling by Electrolysis

RECENT efforts on the part of a number of coal operators in the anthracite fields of Pennsylvania to handle slush from their coal breakers at a profit, and at the same time stop stream pollution, makes timely a process patented by C. E. Holland. This process is intended to clarify any water containing finely divided solids in suspension by passing the water between electrodes through which in turn is passed direct electric current of low voltage. The material in suspension in the electrolyte




ELECTROLYTIC MACHINE USED IN HOLLAND PROCESS.

appears to act as a conductor and each particle becomes ionized. The result is a very rapid coagulation and settling of the material from suspension.

Slush water from the modern breaker contains from 5 to 15 per cent. solids by weight, all of which will pass a $\frac{3}{32}$ in. round-hole screen. It has been demonstrated that, by the use of Dorr thickeners, all plus 150-mesh material can be dewatered and recovered, but the minus 150-mesh material consisting of fine coal with various percentages of ash, on account of its low specific gravity and finely divided state, will remain in suspension indefinitely. By the Holland process, this material can be given a slight electrolytic treatment, which will cause it to settle rapidly so that a thickener will dewater it and will discharge an underflow containing not more than 40 per cent. moisture.

This treatment will mean an absolutely clear water that can be re-used for industrial purposes after being discharged to the rivers. When mine water containing several grains of sulfuric acid per gallon is used for washing coal, even the slight electrolytic treatment required to ionize the material in suspension will at the same time considerably decrease the acid content and a prolonged treatment will entirely eliminate the acid if soluble anodes are used.

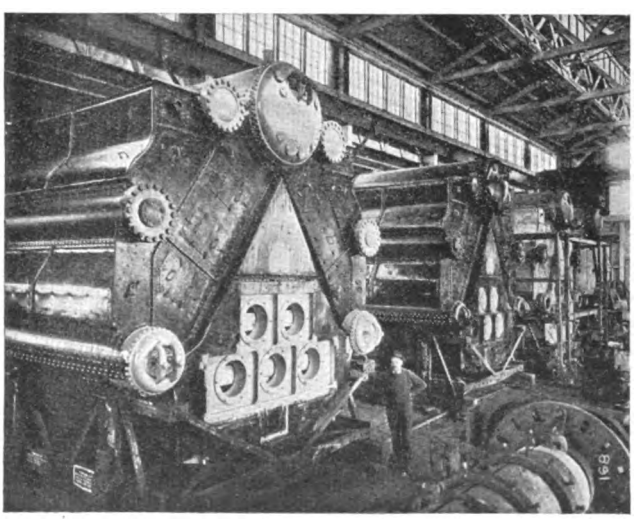
Filtering and drying experiments conducted by means of the Portland filter and Lowden dryer have demonstrated that the recovered material can be filtered and dried to give a bone-dry pulverized fuel, at a reasonable cost. Although this product will contain from 25 to 50 per cent. ash content this can be greatly lowered by flotation before the thickened pulp is sent to the filters.

Mr. Holland's experimental apparatus was installed and operated at the breaker of the Pennsylvania Coal Co. at Old Forge Pa., under the supervision of the Department of Health of the State of Pennsylvania, and the engineers of the Department report that all suspended matter was precipitated and that there was a current consumption of 0.8 kw. per thousand gallons of water treated or 9.5 kw. per ton of solids recovered.

A sketch of Mr. Holland's electrolytic machine is shown here. The overflow from a settling tank carrying fine material in suspension enters a battery at one end near the bottom and flows upwards between the plates. The treatment is practically instantaneous and there is a continuous overflow from the battery to settling tanks where the material in suspension rapidly settles. The area of the electrodes is in direct proportion to the volume of water treated. They may be composed of aluminum, iron or carbon and they may be placed from one-half inch to several inches apart, depending on the conductivity and velocity of flow of the electrolyte. The interior of the battery is insulated with hard rubber to prevent short circuiting. As there is necessarily a slight decomposition of the water, there will also be, over considerable periods of time, a tendency for deposits to build up on the cathode. When this occurs the deposits are dropped by a simple reversion of the poles.

## Marine Boilers, Gold Dredges, and Empire Drills

WHAT are said to be the largest marine boilers ever built in America for the largest ship in the United States Navy are under construction in the plant of the New York Engineering Co., at Yonkers, N. Y. Four boilers have been completed and



BOILER FOR BATTLESHIP MADE BY NEW YORK ENGINEERING CO.

shipped by lighter to the Brooklyn Navy Yard. Under the Navy contract, delivery is not compulsory until July, 1922, but the first delivery has been made eight months in advance of contract requirements. The remaining eight of the order are 80 per cent. finished.

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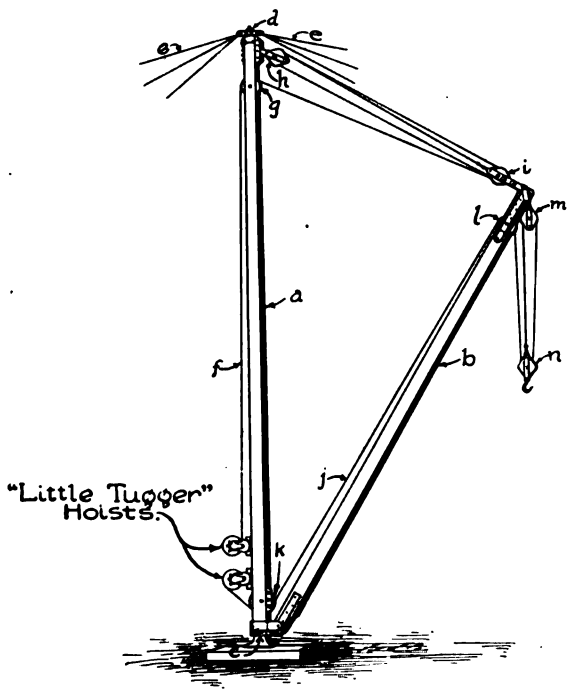
These twelve boilers, known as "The Ludlum Type," will furnish the battleship, if it is not scrapped in the disarmament program, with 90,000 hp. Boilers of this type are also being used by several mining companies in the West.

The New York Engineering Co., of which A. C. Ludlum is president, is better known to the mining profession as builder of gold dredges and the Empire prospecting and sampling drill.

## Little Tugger Derrick

NECESSITY caused the invention of an inexpensive derrick and at the same time showed another use of the Little Tugger hoists, made by Ingersoll-Rand Co.

After a fire which gutted a 600-ton mill, two Little Tugger hoists were used in the construction of the derrick for clearing




LITTLE TUGGER DERRICK.

away the debris to make room for the new mill. This derrick was used in clearing away about 90 per cent. of the wreckage.

The hoists are small, compact drum hoists operated by compressed air or steam, originally used in the company's mines. The mast and the boom were both made from telegraph poles. The mast is carried at the foot by a pivot *d*, held by guy ropes *e*. The boom is pivoted at the lower end of the mast. The rope *f* is connected with the upper hoist and passes over the sheave *g* at the top of the mast and through the pulley *h* at the mast head and *i* at the top of the boom. This rope varies the angle of the boom. The hoisting rope *j* is connected with the lower hoist and passes under the sheave *k* on the mast, over sheave *l* on the boom and through the pulleys *m* and *n*. This is the rope which suspends the load.

The derrick is swung by hand although another Little Tugger, furnished with a bull-wheel, could do this work if it were desired. With the pulley arrangement shown, the derrick is capable of lifting approximately a 3-ton load.

## Industrial Notes

**C. H. Brandes,** formerly chief mechanical engineer and general purchasing agent of the American Metal Co., Ltd., of New York, and its domestic and foreign subsidiaries, has opened offices at 42 Broadway, New York City, for consulting work.

**Hercules Powder Co.** will be glad to send without charge a copy of a paper on Scientific Selection of Explosives for Coal Mining, by N. S. Greensfelder, that was presented at the meeting of the Coal-Mining Institute of America in December. Address Advertising Dept., Hercules Powder Co., Wilmington, Del.

**Combustion Engineering Corpn.,** New York, recently opened two branch offices, one at 216 Latta Arcade, Charlotte, N. C., in charge of T. E. Nott and the other at Seattle, Wash., where Fryer-Barker Co., 1133 Henry Bldg., represents the corporation.

**William Swindell & Brothers,** Pittsburgh, Pa., have established an electric furnace department under the direction of Frank W. Brooke, late vice-president and chief engineer of the Electric Construction Co. of Philadelphia. This department offers the latest design in furnaces for melting steel, gray iron and non-ferrous metals; also a complete line of electric heating furnaces from 30 kw. upwards. A license to operate under the Marsh Patents for the nickel-chromium electric resistance elements has been granted to this firm.

**Bucyrus Company** announces the removal of its New York office to Suite 728, 30 Church St. E. G. Lewis is in charge. Mr. Lewis has been connected with the sales organization of the Bucyrus Company for many years and has had wide experience in railroad and general contracting work in this country and abroad. M. J. Woodhull succeeds Mr. Lewis in charge of the Chicago office, 622 McCormick Building.

E. R. Weber succeeds J. N. Gawthrop at Minneapolis, 1224 McKnight Building. Mr. Gawthrop will join the staff at the New York office.

## Trade Catalogs

**Carbo Steel Products Co.,** 2600 W. 111th St., Chicago, Ill., is again manufacturing Carbo Steel poles.

**Hendrie & Bolthoff Mfg. & Supply Co.,** Denver, Colo.—Pamphlets describing the Bunker Hill Screen and the Allen Vibrating Screen.

**W. S. Rockwell Co.,** 50 Church St., New York.—Bulletin 240. Heat Treatment of Springs with Stationary and Continuous Furnaces. Shows application of principles that must be considered in improving quality and decreasing cost of springs and similar heat-treated products.

**Sullivan Machinery Co.,** Peoples Gas Bldg., Chicago, Ill.—Bulletin 71-G. Air Lift Pumps. A new edition of an old catalog. Gives instructions for use in requesting estimates on installations.

Bulletin 71-F. Displacement Pneumatic Pumps. Describes a new pump intended primarily for handling acids.

Bulletin 70-W. Sullivan Rotators. New edition.

**Mashek Engineering Co.,** 90 West St., New York.—Catalog No. 5, Briquetting Machinery and Plants. A cloth-bound book of 129 pages. The price of the book is $2, but the Mashek Engineering Co. will send the book free of charge to those engaged in coal mining or coal merchandising. About one-half of the book is devoted to briquetting, including lignite, and discusses binders, costs of manufacture and of plants, etc. The remainder of the book gives descriptions and illustrations of the machinery built and of plants erected by the Mashek company.

**Westinghouse Elec. & Mfg. Co.,** E. Pittsburgh, Pa.—Announcement of Westinghouse Merchandising Bureau.

Catalog 7-A. Industrial Lighting Equipment.

Instruction Book 5232. Rectigon Battery Charger Style No. 301860.

Instruction Book 5229. Type F-11. Oil Circuit Breaker (Manually operated).

Instruction Book 5207. Main Roll Drives. A-C and D-C motors.

Catalog 12-A. Safety Switches and Panel Boards

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# MINING AND METALLURGY

FEBRUARY 1922


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# MINING AND METALLURGY

THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
29 West 39th Street, New York City, N.Y.

No. 182 FEBRUARY 1922


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## EDITORIAL

### Producing Capacity

IN GENERAL the mining and manufacturing capacity of the United States is at present greatly overdeveloped and overbuilt. In certain industries, *e.g.*, bituminous coal mining, this was a chronic and characteristic condition even before the war. In other industries it is a consequence of the war. The subject is one of major economic importance. In it are involved the questions of finding other uses for the superfluous capacity, or in default thereof writing it off. Failure to recognize the situation that may exist in an industry in this respect will lead many people to hold on to plant with the hope of realization from it as a going concern long after such hope should be abandoned. This implies that the plants of an industry will be operated only at partial capacity, with consequential inefficiency; that the industry as a whole will be loaded with an exaggerated overhead; and finally that the industry will be maintained in an overmanned condition, with the serious consequence that the personnel as a whole cannot obtain full-time work.

In considering the position of any industry there must obviously be discrimination. Many industries are conducted in numerous stages. Thus, in the production of metals we have first the mine capacity, next the smelting capacity and finally the refining capacity. We may be overbuilt to different degrees in the several stages, or in one stage may perhaps not be overbuilt at all.

It is highly important, of course, to determine what is to be the yardstick for measuring industrial capacity as a whole. Shall it be the pre-war capacity; or the pre-war rate of consumption; or the estimated rate of consumption during the next few years; or what? Without undertaking to answer these questions, it is obvious that anyone speaking in terms of percentages should be careful to describe what he means. Thus, it has been stated frequently of late that the steel works of the United States were operating at only 40 per cent.

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of their ingot capacity. That was a correct statement, but nevertheless it conveys false ideas; among others, that if the scale of operations is only 40 per cent. the industrial situation must be very bad; furthermore, that if it is very bad, it can be very much better.

In fact, the ingot steel producing capacity of the United States is about 52,500,000 tons per annum, but we are overbuilt in such capacity, there never having been use for so much. The production of ingot steel was about 30,000,000 tons in 1913. An increase commensurate with the gain in population would lead us to expect a consumption of perhaps 33,500,000 tons in 1922. Thus, if we are producing now at the rate of 21,000,000 tons per annum we are indeed at 40 per cent. of total capacity, but we are at nearly 62½ per cent. of *useful* capacity.

Similar conditions prevail in most of our industries. Note is to be taken of the discrimination that I make between *total* capacity and *useful* capacity. In a book on the "Wealth and Income of the American People" that I am soon going to publish I go more fully into this subject and utter the principles that plant is only valuable to the extent that use can be made of it, that such use is in its maximum roughly proportional to the number of workers existing and that owing to various causes, including war stimulations, we have created a surplus of capacity, representing billions of dollars, that must simply be written off. This takes into account that every industry should normally have some surplus capacity in order to take care of peak loads, that a good deal of what is listed as live capacity is old plant naturally approaching the state of obsolescence, and other factors.

The principles to which I have given expression imply the need for a correlated and qualifying factor, *i.e.*, as to the efficiency of workers. The 8,000,000 factory workers of the United States, if fully employed may make in 1923, let us say, a larger or smaller output per person than they did in 1913. When we project probable production and consumption in proportion to population we assume that rates will be maintained. This is a subject in the new field of quantitative economics that has not been explored. We are sure that during the century preceding 1913 the output per worker in the long run increased greatly, which is evinced by the immense improvement in the scale of living among civilized people. We know that this was especially attributable to mind which gave to men the help of machines. As to what man himself did we know next to nothing.

Since 1913 we have had more data on this subject. It is not well coördinated and is far from being enough, wherefore any ideas derivable can be nothing more than hazy. To me the indications point toward a certain impairment in the efficiency of labor during the last 10 years. In other words, the output per worker appears to have declined in spite of increased mechanicalization during this period. While saying this I am fully conscious of the quite different showings in individual industries and also the remarkable change for the better that began right after the middle of 1920. If this idea be correct it does not follow that production and consumption in the years immediately coming will be at the pre-war rate, $a$, plus $x$ per cent., corresponding with increase in population, but it may be ($a + x$ per cent.) 0.95, the last element being merely an illustrative factor representing impairment.

This is, of course, equivalent to indicating a deterioration in the scale of living. I am not sure that just that is not already in evidence. In the matters of housing and transportation it certainly is so. Notwithstanding the automobile, the cinematograph and the phonograph, which are doubtful advantages, and the extension of the telephone and the electric light among our homes, I wonder if the American people as a whole are so comfortable now as they were in 1913?

But returning to my initial subject, it will be evident, I think, that American business did not at the end of 1921 stand at the low ebb of 40 per cent. of normal, or anything like that, but rather was it probably around 80 per cent., if we assume normal to be the pre-war rate plus the natural expansion reasonably to be expected by virtue of growth in population. Any other idea would fly in the face of other basic indications, *e.g.*, the extent of unemployment, as to which fallacies are also propagated.

According to governmental estimates not more than 2,000,000 workers in the United States were idle at the end of 1921 compared with 5,000,000 at the end of 1920. These estimates, however, are very vague and it is doubtful whether they ought to be characterized as being much more than imaginary. If data bearing on this subject from various sources be compared, it will be found that things are not very well in tune.

For example, the Committee on Unemployment Statistics of the Merchants Association of New York found that the number of unemployed in the City of New York at the end of 1921 was 331,000, or about 13 per cent. of the 2,531,747 persons in the city reported by the census as being "gainfully employed" on Jan. 1, 1920. The total number of non-agricultural workers in the United States is about 30,000,000. If the same proportion were everywhere unemployed as in the City of New York the total for the United States would be about 3,900,000. In fact, data from other industrial centers appeared to run around 13 to 15 per cent.

Such figures are in no wise surprising in view of the severity of the economic readjustment that is in progress. In normal times the range between the extremes is probably not more than 10 points. With employment at 95 per cent., business is ordinary. At 98 or 99 per cent., there is a boom. At 90 or 92 per cent., there are what we call hard times. Below 90 per cent. there is an unusual crisis, such as the present.

The business affairs of the United States are on a stupendous scale. With 11 million agricultural workers

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and 30 million town workers, a pre-war gross income of about 34 billion dollars and an annual living expense of about 27 billion, it is necessary to have a broad perspective if we are going to try to see things as a whole. The affairs of an individual industry, even a big one, may be a good deal out of line without much affecting the general average. In the long run, however, everything is bound to come pretty much to the same plane. The process of getting there is what we call readjustment.

W. R. INGALLS.

## Columbia Mining Scholarship

COLUMBIA University has requested the American Institute of Mining and Metallurgical Engineers to name the recipient of a scholarship in mining or metallurgy in its School of Mines, Engineering and Chemistry. The Columbia School of Mines is now on a three-year course on a graduate basis. The purpose of this advanced course is to turn out a high type of engineer trained in the humanities as well as in the fundamentals of his profession. It is hoped that by placing a scholarship at the disposal of the A. I. M. E., with its membership represented in all the mining regions of the country, there will result a wide-spread interest which will insure the choice of a candidate of the very highest mental and personal qualifications, who will subsequently reflect unusual credit, not only on himself and his alma mater, but also on the Institute whose candidate he would be.

The Woman's Auxiliary of the A. I. M. E. some time ago established an Educational Fund with which to promote engineering education by selecting worthy candidates and assisting them financially to complete their academic studies. The first recipient of this Woman's Auxiliary award was a Montana high school boy who began his college course at the University of California in September, 1921. Gratifying reports of this young man have been received at the end of his first semester.

Because the Auxiliary, as a going concern, had machinery for searching out and nominating a worthy and desirable candidate for this scholarship, the Board of Directors, in accepting the privilege offered by Columbia, put the administration of this scholarship in the hands of a committee with instructions to coöperate with the Woman's Auxiliary, which has now put its machinery at work in all parts of the country looking forward to this nomination. The details of the qualifications and requirements are given in a special article under the report of the Woman's Auxiliary elsewhere in this issue.

The Columbia Scholarship is $350 per year. To this the Woman's Auxiliary has generously added from its own fund $200, so that the scholarship will be worth to the recipient $550 per year. Reappointment of the student to the scholarship for the completion of his course is conditional on maintenance of good standing in his work.

There is no age limit prescribed for the recipient of this benefit. It would not be displeasing to the Board of Award if the successful candidate were an engineer who had already made some progress in his profession and who might, on account of existing business conditions, now have time for advanced work which otherwise he would be unable to undertake.

It is a notable event that the Institute should be asked to administer this scholarship by Columbia University, and it is no less a matter of congratulation that the Institute should have in its Woman's Auxiliary a functioning organism so well able to undertake this work immediately without the usual mental agony and physical discomfort of preliminary organization.

The recipient of this scholarship should be particularly inspired by its source and its association.

PERCY E. BARBOUR.

## Why Retail Prices are High

THE Attorney General has instituted an investigation of the subject of high prices still prevailing for goods at retail, with the intention of explaining, among other things, the wide variation for the same goods in different places, and to ascertain whether profiteering is still going on. The Attorney General does not need to make any investigation of this subject. Both the facts as to existing conditions and the reasons for them are well known. What is needful is not investigation, but the courage to make a plain exposition of the situation.

The prices for many goods at retail are still very high and there are wide differences among them in various places. That is the statement of fact. The reasons are (1) incompetence on the part of retailers and (2) the exorbitance of labor.

In general the retailing of goods in the United States is done in a wasteful way. There are too many retailers in proportion to the population, whose living is necessarily derived from their margin. To a very large extent these are men of small capacity and their costs of distribution are enhanced by the wastefulness of their methods. All of these merchants found themselves at the beginning of the decline with stocks of goods bought at high prices. Rather than take losses they maintained prices with the idea of getting out whole, even at the expense of diminished volume of business.

The other reason for high retail costs is, of course, the high wages that have continued to prevail for labor, which are reflected in high freight rates, high manufacturing costs and high costs of merchandizing and distribution. The farmer of the South sells his cotton at pre-war prices, but the shirts that are made out of his own cotton cost him two or three times what he used to

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pay. Among the great groups of the nation's workers the farmers have been especially the victims, but great groups among the townworkers have been victimized also.

What is needful in the present juncture is not investigation of anything by the Attorney General, but rather is it educational leadership. There is need for education that will divert the minds of the aggrieved farmers from thoughts of ill-considered agrarian legislation, which is about as useful as the panaceas of old Doctor Swamproot, and turn them toward the true cause of their troubles. When the victimized people and the politicians who represent them cease to be afraid of the labor unions we shall quickly begin to see a change for the better in the matter of retail prices and we shall begin to enter upon the paths of national prosperity.

W. R. INGALLS.

## The Black Future of the Patent Office

MANY mining engineers, mill men, metallurgists, and other members of the Institute are patentees or potential patentees. Besides, the mining and metallurgical industry depends on patented apparatus to carry on its operations. The interests, therefore, which this profession has in an efficient Patent Office are sufficient to warrant personal effort on the part of each member in writing to his Congressmen to urge the early passage of the Lampert Patent Office Relief Bill.

Black as is the immediate outlook for the Patent Office, its future a few months distant seems to promise nothing but complete disorganization. With the industrial activity and progress of the last few years, the work of the Patent Office has been increasing by leaps and bounds. Concurrent with this has been the rise in wages in industry, while the salaries of Patent Office examiners have remained fixed at a rate considered meager many years ago, and the position of patent office examiner, therefore, has become less and less attractive. Resignations have become more frequent, with disastrous results. Not only does it require the repeated training of new men, but it leaves an ineffective and inadequate force which is utterly unable to handle the amount of business in hand. The position of examiner is so unattractive at the present time that the vacancies are not being filled and it is the opinion of people well qualified to judge that if the process of disintegration goes much farther the Patent Office will be stalled.

American Engineering Council, through its Patent Committee, of which Edwin J. Prindle, of New York, is chairman, supported by a large number of other patent lawyers, after a great deal of effort prevailed upon the majority leader in the House, Frank W. Mondell, to call up the Lampert Patent Office Release Bill for immediate action. The difficulty was a stated intention to postpone this legislation until after the passage of the general reclassification of governmental positions. However, success has attended these efforts to the extent of having the bill passed in the House. It must now be passed in the Senate.

The general reclassification bill, even if it should ever become a law, cannot by its terms become effective in less than eighteen months. This delay would be fatal to the Patent Office.

PERCY E. BARBOUR.

## Employment Service to Executives

FOR a number of years the Institute headquarters has taken up with executives of large mining companies and other employers of many men, particularly engineers, the matter of placing as many students as possible at the end of the academic year, so that for those who desired it there would be little interim between the close of their college course and the beginning of their gainful occupation. This service seems to have been much appreciated both by the young men and by the executives.

The Employment Bureau organized by the four national societies, and conducted by their secretaries from the Engineering Societies Building, took over this work but owing to the fact that it is directly under the charge of the four secretaries, it still maintains the intimate membership contact. With the reopening of the country's mines, this Employment Bureau, which now is one of the activities of the Federated American Engineering Societies, finds itself in a particularly fortunate position to furnish to executives of all of these companies any number of engineers, many of them with special attainments. These engineers are so classified that the Bureau can deliver almost anything that is asked for.

Executives and employers of large numbers of engineers are coming more and more to appreciate the value of this Federated American Engineering Service, and the more widely it is used the greater will be its value to all concerned.

PERCY E. BARBOUR.

## Caving Systems of Mining

TWO errors occurred in the article by Mr. J. Parke Channing, in the January number of MINING AND METALLURGY. In the second column on page 7, in the sixth line from the bottom of the column, the fourth word, steep, should be flat, and on page 8, in the third line of the third paragraph, Guy R. Johnson, Sr. should have been J. E. Johnson, Sr.

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# Review of the Month

WITH the economic situation of the world what it is, we may expect important events in every month of 1922, and January showed us somewhat of the nature of things that will happen. The Germans announced their inability to meet in full the reparation payments that were due Jan. 15. The Supreme Council arranged a plan for them to pay some thing on account every 10 days, and called a conference at Cannes to talk things over. While this conference was in progress Premier Briand resigned and was succeeded by Poincaré. This emphasized the growing differences between British and French policies and interests. The French want to exact the utmost from the Germans; so do the British. The latter think, however, that the French aims will so cripple the Germans that they can not work properly and hence can not trade. Great Britain, with a huge unemployment problem, must have trade. The French thought that Briand was unduly deferring to the British and withdrew their support of him.

The other important political developments of the month in Europe were the establishment of the Irish Free State, relieving the British of the vexatious Irish question; and the growing tendency to recognize the Soviet government of Russia and admit its representatives into international conferences.

In the United States the great political event was the establishment of the dominance of the agricultural bloc in the Senate, which implies the passage of agrarian legislation that will probably be unwise.

Economically, there was no progress in the United States. If anything there was probably some recession in the physical volume of business. There were some further reductions of wages, but these were irregular, geographically, and moderate in amount. The great unionized trades maintained the jam. Events of great importance were the formal demand of the anthracite coal miners for increased wages on April 1 and the declaration of the bituminous coal miners that they would resist a reduction at that time. The attitude of these groups is believed to presage labor troubles in the spring.

In the metal markets affairs were dull during January, but prices were generally firm, save for a little further weakening in iron and steel. In the matter of production, however, there was some quickening of activity, especially in copper, zinc and iron.

The mining companies of Butte which had been idle began work on Jan. 16, preparatory to resuming production. All of the companies in the district joined in an agreement to reduce mine, mill and smelter labor 50c. per shift, making $4.25 the basic wage for miners. Anaconda reopened four of its mines. Butte & Superior is now to ship zinc concentrates to the Anaconda electrolytic plant at Great Falls. The lixiviation residues from that plant will go to the East Helena plant of the American Smelting and Refining Co.

Mining operations were gradually increased on the Minnesota iron ranges, unemployment being thereby considerably relieved. There was also an increase in the scale of operations in the Tri-State zinc district.

New freight rates on lead bullion and other smelted products from Tacoma, Kellogg, Northport, and East Helena were approved by the Interstate Commerce Commission and announced as effective Jan. 5, 1922. The new rates are as follows:

| | |
|---|---|
| To Pittsburgh | $13.25 |
| Cleveland | 13.25 |
| Indianapolis | 12.75 |
| Chicago | 12.00 |
| St. Louis | 11.40 |
| Kansas City and Omaha | 10.80 |
| St. Paul, Minneapolis and Duluth | 9.00 |

The rate from Northwestern smelting points to New York remained unchanged at $16.50.

Wage reductions by the smelters in Utah were announced about the middle of the month. Sporadic readjustments were effected elsewhere. On Jan. 1, 1922, the Porcupine mining companies reduced wages approximately 50c. per day. This gives to drill runners $4.75 per day, which is 25c. higher than the Cobalt scale.

In coal mining, conditions continued to be bad owing to the stubborn resistance of the union miners to any modification of the existing wage scale. On this basis many operators could not sell coal at all, with the result that their miners had high wage rates but no income. More and more was the necessary coal supplied by the mines of those fields where the open shop prevails.

A plan for reorganizing the Ray Hercules Copper Co. was announced. The new company will be known as the Ray Hercules Mines Incorporated and will have an authorized capital of $1,000,000 in first mortgage 6 per cent. bonds and 1,200,000 shares of stock of $5 par value.

A general strike of labor in the gold and coal mines of the Transvaal began on Jan. 14. The Federation of Workers (the labor union) complained that non-union workers were being employed and there is dispute over some conditions connected with the employment of native labor. The strike was precipitated through an attempt by the mining companies to reorganize their working forces by greater employment of native labor, particularly in the semi-skilled occupations, in order to decrease working costs.

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The Spanish Government announced the conclusion of the contract with the Rothschilds of London for the sale of the Almaden and Arrayanes quicksilver, which henceforth will be marketed by the government itself.

## The Ratio Between Labor and Output in Mining

By William Kelly

IT IS customary to express the ratio between labor and output in mining as tons per man. Thus, if there are 300 men working at a mine and the output for a day is 600 tons, it is usual to say that the output is 2 tons per man. Let us suppose that of the 300 men, 100 are on surface with an average wage of $3.10 a day, 80 are underground laborers and bosses averaging $3.50 a day and 120 are miners breaking ore at $4 a day. The average of all the wage rates would be $3.566 per day. To find the labor cost from these data, the total number of men must be multiplied by the average of their wages and divided by the output. In this case, it would be 300 × $3.566 ÷ 600 = $1.783.

A more rational method of expressing the ratio between labor and output is the inverse of the above, namely, labor per ton. Thus, in the case cited, 600 tons were produced by 300 men or 0.5 days work per ton. This method lends itself readily to subdivision between different classes of labor and the relative cost per ton of each; thus, with an output of 600 tons there would be as above:

| | No. Men | Labor per Ton | Average Wages | Cost Per Ton |
|---|---|---|---|---|
| Miners | 120 | 0.200 | $4.00 | $0.80 |
| Underground labor | 80 | 0.133 | 3.50 | 0.467 |
| Surface labor | 100 | 0.167 | 3.10 | 0.516 |
| Total | 300 | 0.500 | $3.566 | $1.783 |

The subdivisions can be carried out for other classes of labor—trammers, timbermen, hoisting engineers, shop men—as desired and, with the average wages of the class, these elements of the cost can be computed easily.

On the same basis of wages, unless there are radical changes in the character of the operations, the average wages are not likely to vary more than a cent or two from month to month and, though the daily variations are more than this, the general average of wages will give results sufficiently close for daily comparisons.

To compare the efficiency of work under different wages scales or the results obtained at different mines, the wage rates and cost per ton must be disregarded and the comparison made either on the basis of tons per man or labor per ton. While the tons per man may suffice for the total result, it does not show well the relation of the different parts of the work. Thus in the example used, the tons per man for miners is 5, for underground labor is 7.5, for surface labor is 6, and for all classes is 2, but these figures give us no idea of the proportionate part of the work done by the different classes of labor. In comparing the results at different mines or at the same mine under changed conditions, it is difficult to draw conclusions from such figures. Expressing the ratio in labor per ton not only gives total results, which are comparable, but the figures may also be used to show the proportion between the different classes of work. To be consistent, if figures are carried in tons per man, the cost should be figured as tons per dollar.

## Personnel Research Federation

THE first annual meeting of the Personnel Research Federation was held in the National Research Council building, Nov. 21, 1921. The membership was increased from 8 to 24. Approximately 50 representatives were present from industrial establishments, colleges, universities, American Federation of Labor, U. S. Government bureaus, personnel research organizations, Engineering Foundation and several divisions of National Research Council.

During the all-day meeting, addresses were made by Chairman Yerkes, Vice-Chairman Gompers (read by Mr. Matthew Woll), and Secretary Flinn; Dr. J. David Thompson, on behalf of Commissioner of Labor Statistics Stewart, presented advance copies of *Bulletin* 299, of the Bureau, entitled "Personnel Research Agencies." Valuable papers were read by C. S. Yoakum, director Bureau of Personnel Research, Carnegie Institute of Technology, Pittsburgh; Joseph W. Hayes, of the Scott Co.; L. L. Thurstone, of the Carnegie Institute of Technology; Miss Anna Bezanson, of the Wharton School of Commerce, University of Pennsylvania. Officers were elected as follows:

Chairman—Robert M. Yerkes, National Research Council;
Vice-chairman—Samuel Gompers, American Federation of Labor;
Secretary—Alfred D. Flinn, Engineering Foundation;
Treasurer—Robert W. Bruere, Bureau of Industrial Research;
Director—Columbia University.

## Standardization of Wood-testing Methods

THE American Society for Testing Materials and the U. S. Forest Service have been designated by the American Engineering Standards Committee as joint sponsors for the development of uniform standard methods of testing wood. This action was taken after a canvass of the principal national bodies concerned with the proposed project, from which it was apparent that there is a real demand for the work, and that the joint sponsorship here indicated would be acceptable to the industry.

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# British Oil Policy in Foreign Fields

By SIR JOHN CADMAN

President of the Institution of Mining Engineers of Great Britain

IN THE changed circumstances which now confront the world, an international open-door policy is the only way to keep pace with the world's demand for oil. You may rest assured that as far as the British Empire is concerned, American capital for the development of oil resources is welcome, and little obstruction will be found in the way to permit the use of foreign capital in the group of countries which constitute the British Empire.

In the war days we worked in close coöperation and harmony, but in disbandment of the Petroleum War Service Committee, when the war ended, I feel that it left its task unfinished. In the wake of war there appeared a ghost of war-time conditions in the form of belief that Great Britain was straining to corner the petroleum resources of the world. I am certain that if the war-service committee had continued its work in the period of reconstruction the real story would be known and this sinister ghost would have long since vanished before the truth.

### Great Britain Not in the Oil Business

With respect to the three most misleading fallacies about Great Britain's oil policy, I cannot emphasize too strongly the following facts:

1. *It is not true* that the British Government is engaged in the oil business and controls the Anglo-Persian and Royal-Dutch companies.

2. *It is not true* that Great Britain is trying to secure a monopoly of the petroleum resources of the world.

3. *It is not true* that Great Britain is shutting out American citizens and American capital.

Let me tell you briefly what is the truth about these matters:

One is led to believe that the British Government is a great oil company, and that it has as its subsidiaries such companies as the Royal Dutch Shell and Anglo-Persian companies. Rumor asks you whether you can afford to become dependent for even a portion of your crude petroleum upon such a British oil corporation, and especially upon a great Anglo-Persian-Royal-Dutch-Shell combine. You are asked to believe that within a few years your own internal source of supply will be exhausted.

Emphatically, the British Government is not in the oil business. She does not control the Royal Dutch Shell—she does not have a single share in that corporation, which is controlled by foreigners—and with the exception of holding shares in the Anglo-Persian Oil Co., the British Government is not interested in oil companies, and certainly has no control over the commercial management of the Anglo-Persian Oil Co.

The Anglo-Persian Oil Co., with which I am associated, was formed in 1909 to take over and exploit certain concessions which had been acquired in 1901 by a Mr. D'Arcy. After an up-hill fight, the company met with a certain measure of success, and, in 1913, acquired additional capital to carry on its work.

### Investigated Source of Supply Before Making Contract

At this period money was not easy to procure for oil ventures. An attempt was made to sell to the British Naval Department a certain supply of fuel oil and to secure payment in advance. It was necessary for the Naval Department to assure itself that the supply of oil would be forthcoming before agreeing to any such payment; and with this object in view a small Naval Commission was sent to Persia to investigate the source of supply. I happened to be one of the technical members of the commission.

The result of the inquiry was satisfactory and the terms of the contract agreed upon. It then became necessary to find some security for the financial advances to be made, and the plan was hit upon of increasing the capital of the company and allotting to the British Treasury ordinary shares for these funds. Two Government directors were appointed to the board, but it was agreed that these directors were not to interfere in any shape or form with the commercial policy or management of the company.

### Government an Ordinary Shareholder

This arrangement was made in 1914 and the position is the same today. The Government still has its contract for fuel oil with the company, is still an ordinary shareholder, but has no voice in the management of the company. The reason for this arrangement was a full recognition by both sides of the inadvisability of Government trading, and the inability of the Government to properly administer a commercial concern.

I cannot help feeling, however, that the company has suffered from the presence of its sleeping partners, by the inference, which is wholly incorrect, that the Government exercises an influence over the commercial affairs of the company. The operations of the com-

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pany have been very successful, but these have been achieved not because of, but in spite of, the Government holding.

Great Britain consumed the greater part of the petroleum products sent over by America during the war and was ever crying for more and more oil. The demand for oil and the high price have attracted British companies to greater endeavor to find oil, but many of these companies are more interested in selling stock than in finding oil.

Years ago, when great distributing companies pursued a policy of selling their own oil and not producing, an impression arose that such companies endeavored to shut off new sources of supply, such as Burma and Trinidad, and for that reason certain measures of assistance were afforded independent British companies. As a matter of fact, the protection of independents in certain parts of the British Empire was even less drastic than the Sherman and similar laws in America.

Since the war, the whole petroleum picture has changed. Your own supplies no longer enable you to meet the great demand for the home market and it is not unnatural that you should proceed at once to explore foreign sources of supply. American companies, anxious to go abroad and develop petroleum resources, will find that while the group of countries which constitute the British Empire subscribe their own conditions, the British people welcome American capital; the door is open, in fact a very open door with few exceptions, and where there are now restrictions, they will soon be removed.

A weird picture has also been drawn about Mesopotamia. The fact is that the ownership of the oil deposits in Mesopotamia will be secured to the Arab state as part of the administrative arrangements under the treaty mandate. The interests of the Arab state will be carefully safeguarded. That is the first charge upon the Government that is to exercise this mandate. It must also be realized that due consideration will have to be given to rights legally secured before the war and that any such rights can be considered only when the new government is set up.

Great Britain is denying the opportunity to all nationals, her own included, to make any superficial examination of these areas for commercial purposes until such time as she has been definitely charged with the mandate.

Beyond that it has been stated that in the San Remo agreement, Great Britain and France have parcelled out Mesopotamia between themselves. As one of the signatories of that agreement, I can assure you that there was nothing in the minds of the framers that was against the interest of the United States or any other country. In no part of that agreement is there a suggestion of discrimination, nor was it the intention to discriminate against any similar reciprocal arrangement with any other country. Its principal object was to secure an arrangement that would be of lasting benefit to the Arab state when constituted, which could not be secured under any other arrangement.

We in Great Britain feel the same way about the Government in business as you do in the United States. If I were to tell you the story of the British Government's attempt to manage industries during and subsequent to the war, particularly with regard to coal and the railroads, I should relate a very sordid tale. The British public has had enough of Government interference with commercial affairs to last for a life time, and any person who tried to get a seat in the House of Commons on such a platform would be doomed to the bottom of the poll. If there is any suggestion that your government should take a direct interest in your oil industry, I trust you will give thought to the recent experience of government control in Great Britain.

The petroleum industry in its present highly developed state requires the integrity and capacity of the great leaders of industry—men who have been trained in business and technique and for whom political service holds no attraction. I think the lesson which the petroleum industry has learned out of its war experience is to realize fully its responsibility to the public, if it is to enjoy freedom from Government control or interference.

The solution lies within the industry itself, by getting together to promote its welfare by common consent of its members and by coöperating in every possible way. The work that has already been done in the United States is a model which other countries may well try to emulate and international coöperation between such organizations will then become possible and effective.

What the world wants as much as anything is cheap power. We can realize success in the great project which lies before us all in close coöperation and the resumption of those high ideals which prompted such harmonious and satisfactory partnership during the war.

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## War Department Using A.E.S.C. Standards

THE Secretary of War has directed that the supply branches of the army utilize, in connection with their specifications, the standards that have been or may be adopted by the American Engineering Standards Committee.

"The importance of standardization of war supplies cannot be exaggerated," said Colonel George S. Gibbs, of the General Staff, in a recent address before the American Mining Congress. "In these days war involves the united effort of an entire nation and the combined employment of all of its principal industries.

"It requires no imagination to see how tremendously both the business and military interests of the War Department can be assisted by standardization. It may be safely predicted that business firms dealing with the War Department will find a steady and gratifying improvement in the clearness and simplicity of its requirements."

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# Present and Future of the Copper Industry

By CORNELIUS F. KELLEY

President, Anaconda Copper Mining Company

I HAVE been asked to discuss "What Can be Done to Revive the Mining Industry," particularly from the standpoint of the copper industry. It is impossible to consider this problem, if in fact there can be one, from an isolated position. The mining industry is but a part, although a very important one, of that exceedingly complicated machine characterized as commerce, which comprises within its operation and functions the multitudinous activities that, combined, make up the sum total of the production, manufacture, distribution, sale and utilization of goods and products resulting from the agrarian, industrial and commercial effort of mankind.

We survey a world today with its disturbed mass of humanity permeated with discontent, passions loosened by brutal combat not yet brought under control, class hatreds aroused, national prejudices in a state of stimulated excitement, governments for the most part enfeebled, some destroyed to their foundations, with fragile structures raised in place of those that seemed enduring, and which have disappeared. A burden of indebtedness incurred in defiance of all economic law exists, to meet the exactions of which, levies of taxation that constitute a grievous burden upon effort and industry are exacted by the needs of those nations that are most favored, while printing presses are busy manufacturing currency that either has, or approaches, a negative value among those less favored. This picture, while not pleasant, is one that should be looked at squarely and carefully appraised in estimating the immediate future.

For four years the world marshalled, and exerted without stint, its combined endurance, vitality and resource in an effort of destruction, which violated no less the orderly working of physical and economic laws than it did the conventions of social and civic relations. To have imagined that without travail the orderly processes that governed the relations of mankind could at once be reestablished and begin functioning, was, as has been demonstrated, fallacious; perhaps no more so than the error that is committed today by those opportunists who fail to take cognizance of basic conditions which must be remedied before the world can resume its progress to a universally prosperous and satisfactory condition.

Please do not gather from this somewhat unpleasant recital that I regard the future with gloomy foreboding or entertain pessimistic doubts, for, emphatically, I do not.

* Address at meeting of New York Local Section, Dec. 7, 1921.

While the magnitude of the disaster that has over taken the world is greater than any that has occurred before, and the disarrangement more complete than in any previous experience, the student of history knows that the difference lies largely in the extent of the damage and the difficulty of repair. Progress has been checked, not stopped; prosperity impaired, not destroyed. Civilization has suffered a grievous wound, but its ultimate destiny is coexistent with the instinct of progress in the human race.

These general observations have been induced as a foundation for the assertion that the revival of prosperity in the mining industry, particularly in the copper business, is not a topic of isolated consideration, apart from the larger aspect of the world's industrial and financial status. It must be viewed from its proper relation to the world's business, and while we no doubt have problems that are particular to our industry, which we must solve in order to realize for it the greatest prosperity to which it can attain, we cannot disregard the effect of economic forces of world-wide influence, and hope, as do some, according to attributed declarations, that we can lift ourselves up by the bootstraps into the sun of a beneficent prosperity while depression hangs like a mist enshrouding other cognate and related activities.

## The World, and Therefore the Copper Industry, Will Inevitably Progress

Sooner or later, the idea that political action alone can remedy existing economic conditions will be abandoned. The truth of the law of gravity will be reestablished and serious attention will be paid to the subject, now somewhat obscured by the pageantry of current events, that the fundamental problems of the cost of production and the facility with which commodities representing the wealth of the world can be transported and distributed from sources of origin to points of distribution and consumption, are important factors in the situation.

At this critical juncture in the world's history, one must either take the position that the world is going to make progress, or that it is going to retrogress. That the latter course is its destiny is inconceivable to the normal mind. It is contrary to the dictates of religion, history, experience and common sense.

In physics, we were taught the laws of the composition of concurrent forces, and the truths derived from

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such study have application in finance and industry. Granting that there must be a composition of forces which at the moment seem conflicting, and to the timid presage disaster, the inevitable result will be along the line of progress, and if so, there can be no doubt of the future of the mining industry, particularly that branch devoted to copper mining and manufacture.

If you are a bull on the future of the world, then be a bull on the copper industry. If you are unwilling to hazard a conviction that the world is to go ahead, there is no reason why you should have a conviction about anything; and more particularly, there is little reason why such a conviction should be of interest to anybody.

The foregoing assumes that there is nothing inherently wrong with the copper industry aside from the extent to which it is involved in a world-wide situation. Is this assumption susceptible of demonstration?

It would be interesting, in support of our text, to trace the development of the industry from its early beginnings when sailing vessels bound from Chile around the Horn to Europe found it profitable to deviate from their course to drop a few copper bars at Baltimore to supply the small demand of a country that had then developed no domestic supply of the metal; or to follow, from its initiation in the Naugatuck Valley, the development of a modest effort to manufacture brass buttons, then a common article of utility and adornment, which has brought about the gigantic industry of mining, metallurgy and manufacturing of copper and copper products as it exists today; but for the present purpose it is unnecessary to do so.

The story is a record of achievement. It embodies the romance of the Western pioneer with the ingenuity of the Yankee manufacture. It is a factor concurrent with the progress of the last half century, and symbolized, and to a great extent controlled, the turning of the world from the direct agency of steam to the more potent, facile and economically applied force of electricity as a motive and communicating agent.

To appraise intelligently the situation today, it is only necessary to scan the industry for a period of 20 years. This period, brief in time, has been epochal in accomplishment, for during it the production of ore, beneficiation of its contents and consumption of the product, outstripped all previous periods and established a record that rivals the achievement in any other line of industrial effort.

The war, with the accompanying necessity for metal for munition purposes, completely dislocated the industry and while apparently giving it a temporary prosperity, resulted in seriously impairing its status.

The world's production of copper in 1900 was approximately one billion pounds. The *Engineering and Mining Journal* published an output of 1,093,115,320 lb.; the Geological Survey, 1,089,984,000 lb. Of this total output, the production of the United States was approximately 55 per cent. The same authorities published respectively, 600,832,960 lb. and 606,117,166 lb. as the proportion of this country's production to the whole.

The succeeding decade was marked by an extraordinary increase in production, due generally to bringing into operating activity the low-grade copper deposits, known as the porphyries, capable of making a large output upon a relatively small capital investment and at a comparatively low cost.

In 1912, the world's production had increased to 2,240,246,177 lb., and that of the United States to 1,243,268,720 lb., an increase above the output of 1900, in both foreign and domestic, of about 100 per cent. The percentage of domestic production remained about 55 per cent. The peak of the world's production was reached in 1917, with an output of 3,137,659,472 lb., of which 1,886,120,721 lb., or 60 per cent., was domestic. The peak of the United States production occurred in 1916, when an output was reached of 1,927,850,548 lb., or 62.7 per cent., of a total of 3,070,930,639 lb. for that year.

It is interesting to note that while the world's production has increased, from 1900, a maximum of about 187 per cent., and that of the United States a maximum of 218 per cent., the proportion maintained between domestic and foreign production has been fairly constant, on a percentage basis, to wit: 55.6 per cent. in 1900, a maximum proportion of 62.7 per cent. in 1916, and 62.3 per cent. in 1920.

TABLE 1.—*Production of Some Basic Commodities*

| | 1900 | 1912 (1913) | Peak War Year | 1919 Latest Available |
|---|---|---|---|---|
| Pig iron—World | | | | |
| Long tons | 40,181,865 | 77,714,417 | 70,399,905 | |
| Per cent. increase | | 93.41 | 75.20 | |
| Pig iron—U. S. | | | | |
| Long tons | 13,789,242 | 29,726,937 | 39,434,797 | 36,925,987 |
| Per cent. increase | | 115.58 | 185.98 | 167.79 |
| Petroleum | | | | |
| Barrels | 63,600,000 | 222,900,000 | 222,900,000 | 377,700,000 |
| Per cent. increase | | 250.47 | 493.87 | 493.87 |
| Steel | | | | |
| Long tons | 10,188,329 | 31,251,303 | 45,060,607 | 41,000,000 |
| Per cent. increase | | 206.74 | 342.28 | 302.42 |
| Aluminum—U. S. | | | | |
| Pounds | 7,150,000 | 40,000,000 | 225,000,000 | 198,000,000 |
| Per cent. increase | | 459.44 | 3046.85 | 2669.23 |
| Silk | | | | |
| Pounds | 9,670,000 | 29,590,000 | 55,520,000 | 55,520,000 |
| Per cent. increase | | 206.00 | 474.15 | 474.15 |
| Wool | | | | |
| Pounds | 420,200,000 | 510,200,000 | 821,800,000 | 721,200,000 |
| Per cent. increase | | 21.42 | 95.57 | 71.63 |
| Cotton | | | | |
| Bales | 3,687,000 | 5,400,000 | 7,721,000 | 6,289,000 |
| Per cent. increase | | 46.46 | 109.41 | 70.57 |
| Wheat | | | | |
| Bushels | 339,900,000 | 623,900,000 | 730,300,000 | 681,800,000 |
| Per cent. increase | | 83.55 | 114.78 | 100.59 |
| Population—United States. | | 75,990,000–95,170,000 | | 104,460,000 |

Any survey of the copper industry must look at this large increase of production squarely, and no forecast that attempts either to disregard or minimize its impor-

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tance can find acceptance by those who give the matter intelligent consideration. Conversely, production data in themselves mean little, for to draw a conclusion from the increase above cited, without further study, would be to measure its consequence from a standpoint that disregarded the changes that have occurred in consumptive demand, actual or potential, during the period under discussion.

It is interesting to note, for the purpose of gaining an impression from comparative statistics, the relative increase in the production of some other basic commodities during the same 20-year period.

Table 1 shows the production in 1900, 1912 and the peak production within that time, of a few basic commodities.

TABLE 2.—*Estimated Consumption of Copper in the United States*

| | 1919 | | 1920 | |
|---|---|---|---|---|
| | Pounds | Per Cent. | Pounds | Per Cent. |
| Electrical manufactures | 284,000,000 | 23.48 | 340,000,000 | 26.12 |
| Telephones and telegraph | 65,679,218 | 5.43 | 100,000,000 | 7.68 |
| Wire (not included elsewhere) | 160,000,000 | 13.23 | 190,000,000 | 14.59 |
| Automobiles | 92,965,000 | 7.68 | 99,320,400 | 7.63 |
| Locomotives | 8,998,000 | 0.74 | 9,457,250 | 0.73 |
| Railway cars—freight | 15,676,400 | 1.30 | 7,543,500 | 0.58 |
| Railway cars—passenger | 156,400 | 0.01 | 576,000 | 0.04 |
| Steam railways—electrified | 250,000 | 0.02 | 2,200,000 | 0.17 |
| Shipbuilding | 101,884,625 | 8.42 | 61,906,325 | 4.76 |
| Buildings | 76,778,800 | 6.35 | 53,443,200 | 4.10 |
| Ammunition | 23,000,000 | 1.90 | 23,400,000 | 1.80 |
| Fire extinguishers | 2,000,000 | 0.16 | 2,100,000 | 0.16 |
| Pins | 2,000,000 | 0.16 | 2,000,000 | 0.15 |
| Valves | 10,000,000 | 0.83 | 10,000,000 | 0.77 |
| Coins | 2,075,321 | 0.17 | 3,148,863 | 0.24 |
| Bearing metal—steam railways | 45,000,000 | 3.72 | 45,000,000 | 3.46 |
| Cash registers | 1,300,000 | 0.11 | 1,340,000 | 0.10 |
| Condensers | 10,000,000 | 0.83 | 6,000,000 | 0.46 |
| Miscellaneous | 150,000,000 | 12.40 | 180,000,000 | 13.83 |
| Total | 1,051,763,764 | 86.94 | 1,137,435,538 | 87.37 |
| Exported in manufactures | 157,965,641 | 13.06 | 164,420,412 | 12.63 |
| Total in manufactures | 1,209,729,405 | 100.00 | 1,301,855,950 | 100.00 |

The impression that one obtains from these statistics is that the increase in the production of copper has not been disproportionately large as compared to that of other commodities, particularly when consideration is given to the industries in which the product finds its ultimate utilization.

There is no doubt that during the war years production was stimulated to an output exceeding an economic maximum, and that copper was largely diverted from lines which if developed would have produced an increased consumptive demand. It is likewise true that the variety and essential character of the industries where copper is used are the best guarantees of the future.

As indicative of the ultimate uses of copper, estimates of consumptive demand in the United States for the years 1919 and 1920 are submitted in Table 2. The conclusion that follows inevitably from the foregoing summary is that if the world is to progress along the most required lines, and no other premise can be assumed as the basis of industrial effort, the variety of the markets available for copper listed here compares favorably with those available to any other commodity.

Electrification of the world will continue to advance, particularly along the lines of communication and transportation. The building industry must meet the requirement of housing the people of the world and their activities. An industry of which the prosperity is assured by the progress that must be made along these lines finds itself in a particularly favored position as to its comparative position upon a resumption of normal conditions.

Since the signing of the Armistice, the copper industry has suffered critically, but it is my conviction that the day of its greatest travail has passed. Completely dislocated by war demand, operated practically as a Government adjunct during our participation in the war, required to maintain a production that the producers felt, after the first six months of 1918, was unwarranted and constituted a menace to the industry, the abrupt termination of war demand completed the demoralization of the industry, which found itself with a stock of copper that must be marketed before an economically sound basis could be reestablished. No industry has been more completely liquidated, and no industry is in a better position today to go forward, provided the world itself is to move in that direction.

On Jan. 1, 1919, the stock of copper, according to the best available statistics, assumed the unprecedented total of 2,278,812,300 lb., made up as follows:

| | Copper, Pounds |
|---|---|
| Producers | |
| Crude | 340,314,000 |
| Process | 319,196,000 |
| Refined | 180,000,000 |
| Total | 839,510,000 |
| Governments | |
| United States | 128,714,200 |
| Great Britain | 179,200,000 |
| France | 168,000,000 |
| Italy | 67,200,000 |
| Germany | 67,200,000 |
| Japan | 20,160,000 |
| Total | 630,474,200 |
| Scrap, in Brass, etc. | |
| United States | 92,028,100 |
| Great Britain | 369,600,000 |
| France | 224,000,000 |
| Italy | 44,800,000 |
| Germany | 67,200,000 |
| Japan | 11,200,000 |
| Total | 808,828,100 |

to which amount, in order to bring the situation to the beginning of 1921, there should be added the production of 1919 and 1920, respectively, as follows:

| | 1919 | 1920 |
|---|---|---|
| United States | 1,310,972,580 | 1,343,945,000 |
| Others | 809,909,940 | 813,893,230 |
| Total | 2,120,882,520 | 2,157,838,230 |

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or a total, for the two years, of 4,278,720,750, which, added to the stock of Jan. 1, 1919, gives a total of 6,557,533,050 lb. to account for.

The stocks on hand Jan. 1, 1921, have been estimated at 1,764,632,540 lb. made up as follows:

| | Copper, Pounds |
|---|---|
| Producers | |
| Crude | 300,550,000 |
| Process | 229,002,000 |
| Refined | 641,474,000 |
| Total | 1,171,026,000 |
| Governments | |
| United States | 14,158,520 |
| Great Britain | 26,087,040 |
| France | 12,658,240 |
| Italy | 58,240,000 |
| Japan | 73,136,000 |
| Total | 184,279,800 |
| Scrap, in Brass, etc. | |
| United States | 10,606,740 |
| Great Britain | 302,400,000 |
| France | 67,200,000 |
| Italy | 29,120,000 |
| Total | 409,326,740 |

The difference between the above 6,557,533,050 lb. and 1,764,632,540 lb. equals 4,792,900,510 lb., an indicated average consumption for the years 1919 and 1920, respectively, of 2,396,450,255 lb. This is an amount greater than the entire copper industry ever produced prior to the year 1915, and if during the years 1919 and 1920, the world, with the far from normal export demand that existed, actually furnished a market for more than 2,300,000,000 lb. of copper annually, instead of there being any cause for pessimism, the facts should be regarded as a conclusive demonstration of the basic soundness of the industry, for there can be no doubt that during the years of 1916, 1917 and 1918, production was forced beyond a normal economic maximum, and upon a resumption of normal business, the difference between the demand of 1919 and 1920 and that which should ensue will furnish a market for the normal maximum economic output that the industry can furnish.

During the two years above analyzed, it is estimated that the producers furnished, from current production, 3,947,204,750 lb., and that from Government stocks and scrap, brass, etc., a total of 446,194,400 and 399,501,360 lb., respectively, were obtained.

This brings us to a consideration of the present status of the industry. Actual statistics are not yet available, but it is well known that the great part of Government stocks and scrap metals have been liquidated. Stocks in hands of producers have decreased with satisfying rapidity, until the close of the year finds the metal in a fair statistical position, most reliable estimates placing total of all copper at smelters and refineries, in blister, process or refined form, at about 850,000,000 lb. The greater part, approximately, 550,000,000 lb., is refined. This is somewhat more than should be carried under normal conditions and tends to obscure the actual situation. Probably more than one-third of this amount has already been sold for future delivery, without considering the sale to the Copper Export Association for shipment abroad. The remainder, supplemented by current production from the few properties now operating, can meet even the present demand for only a few months—and what then?

Consumption in 1919 and 1920 averaged practically 200,000,000 lb. per month. The sales for the last quarter will average about 140,000,000 lb. per month. The decrease in stock, after taking in current production, would be more than 70,000,000 lb. per month. It takes, under favorable conditions, three months, on an average, for copper in the mine to be put in marketable form as refined electrolytic copper. This means that when the industry is under way and running smoothly, assuming a market demand of 150,000,000 lb. per month, 450,000,000 lb. of copper will have to be mined to fill up the reservoir from mine to mill to smelter to refinery, including working stocks on hand, before any copper from the mines now down is available for the fabricator. As a matter of fact, how long it will take to reach a reasonable output, no one can say. An assumption that in three months there can be a perpendicular increase is unwarranted, for this will differ with the locality and character of the individual operation.

It is not desirable that there should be any shortage of copper available for manufacture, any more than that the industry ever again should face an accumulation of stocks such as resulted from an effort to meet a war necessity; when the risk of accumulation was known, but when national existence was at stake. Industrial risks did not and could not count.

The copper industry will come into its own again, and that speedily, when business resumes. There has been, under the conditions, a demand out of proportion for that of other commodities. The exports for the year will show 65 per cent. of a pre-war maximum; the domestic consumption, 90 per cent. Under these conditions, let us take heart. Civilization will soon be calling on the miner to pick up his tools, and we shall be on our way to the activity and prosperity we so eagerly anticipate.

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# Readjustment in the Coal Industry*

By T. H. WATKINS

President, Pennsylvania Coal & Coke Corporation

COAL is the basis upon which the activities of the industrial nations of the world rest today. In order that the coal industry may be restored to a reasonably healthy condition, it is essential that both the operator and the miner should understand that they are directly concerned and that their selfish interests demand that they take an active, intelligent, self-sacrificing view of the entire situation and do their part in restoring and repairing the economic structure. Foreign credits, foreign debts, unstable exchanges, destroyed markets, and inability through lack of credit to carry on as before, all require our attention and coöperation.

### Deep Concern as to Future

There is deep concern as to the future and a realization on the part of some of these leaders of industry that they will have to sacrifice their personal time, away from their desks and the details of business, in order to coöperate with other groups in studying the situation and endeavoring to find the best method of utilizing their knowledge in improving conditions and averting further disaster. It is most unfortunate for the country and for labor itself that the labor chiefs are blind to these necessities, and hostile to every effort to secure their coöperation in rebuilding prosperity.

One factor stands out clearly, *i.e.*, that during the war and after the war, until the collapse that occurred a year ago, the country as a whole was on a false basis. We were nearly all deceived and went blindly ahead in a vicious circle to which speculation, profiteering, wage advances, transportation rates and government experiments all contributed. In certain lines, great progress has been made towards a proper readjustment. Profits, unfortunately, in many industries have disappeared entirely; in others, margins have been cut so close that there is not an adequate return for capital. Capital is timid and, after the disastrous experience it has just gone through, hesitates to invest in anything except underlying, safe securities. We see our government securities advancing; we see good mortgages, good underlying bonds, advancing, but we do not see the credit of our railroads restored. We do not see capital seeking investment in the coal industry, or in the copper industry, or in the steel and iron industry; all of these are over-developed, and it will be many years before the demand catches up with the capacity of the mines, the mills and the factories, the productive capacities of which were so largely increased because of temporary demands of war.

This country used and shipped to Europe 50,000,000 tons of steel for war purposes. The industrial and domestic demand will not take care of more than 50 to 60 per cent. of the capacity of these great iron and steel plants. Coal mines, many of which were opened to take care of the abnormal demand, are now without a market for more than 60 to 70 per cent. of their capacity; the return to normalcy will be slow, but it will come more quickly when we fully understand that the only secure basis of a real prosperity is work and thrift.

We have had on our railroads, in our coal mines, and in many other industries, men who are leaders of men and heads of unions, together with a lot of theorists, preaching that all such sentiments as I have expressed are fallacious and unsound and that they are inspired by an utterly selfish group. They will not credit the great men who have helped build up the wonderful industrial development of this country with any humane instincts, or any desire to be fair, but say that it is a deliberately thought-out conspiracy to break up the unions and pauperize labor.

### Leader of Radical Propaganda

The president of the United Mine Workers of America, an organization claiming to have a membership of over 500,000, is one of the leaders in this radical propaganda. He is recently quoted as saying:

> The cruel theory held by a minority of employers in the United States that the worker should be forced to labor for the smallest possible wage that can be forced upon him is the theory that has caused the greatest and bitterest struggles between capital and labor.
>
> While the number of such employers is small they are largely men who are in control of the gigantic manufacturing and producing corporations of America that give employment to scores of thousands. They stand together under that dire banner, "Lower Wages and Higher Profits," a slogan that openly asserts their right, or might, to seize from both producer and consumer."

The condition in which we find ourselves today was foreseen by far-sighted men a year or more before the crash came, but all of their efforts to point out the dangers confronting us were ignored as completely as were the warnings of the men who predicted that Germany was prèparing for war two years before hostilities commenced.

Bituminous coal and its transportation and consumption are affected directly and immediately by the

*Address at meeting of New York Local Section, Dec. 7, 1921.

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changes occurring in our business activities. Approximate figures show that 13 per cent. of the production of bituminous coal is used for domestic purposes; about 28 per cent. by our steam railroads; 12½ per cent. by public utilities; about 12 per cent. for export and bunker trade; 15 per cent. in the steel industry; and 19½ per cent. for general manufacturing.

Approximate figures show that 43 per cent. of this coal consumption is in the summer months, from April 1 to Oct. 1, leaving 57 per cent. for the winter, but, on account of the stocking up in summer months, and taking the country's production as a whole, statistics show that for the past eight years 49 per cent. of the total coal has been produced during the summer months. This shows that there has been less intermittency of employment than in any other industry. In other words, the miners as a whole have not suffered as much from lack of work through this depression as the men employed in the steel and iron industry and in other important lines of manufacture. It is estimated, however, that with the more efficient mines of the country actively employed throughout the year, the demand for coal could be supplied with from 150,000 to 200,000 fewer men.

### Advantage of Carrying Coal Stock

If a scheme could be devised by which buyers and consumers of coal could be convinced of a stable market and a regular supply, they would unquestionably carry reasonable stocks, avoiding excessive stocking up at times for fear of strikes, avoiding at other times the depletion of their reserves, and a very important part of the intermittency of employment would be avoided; the burden of carrying this excessive man power would be relieved and those men would be free to go to other occupations.

There is something fundamentally wrong when 30 per cent. of an overload of labor is carried by such a great industry. The miners' leaders realize this to a certain extent, but, in my judgment, have an absurd or dangerous suggestion or demand, as expressed in their last annual convention, for the correction of it, *i.e.*, a six-hour day and a five-day week working schedule. Not only would their suggestion continue the overburden, but it would disturb and disrupt every other line of industry.

The work of those employed in and about the mines in mining, handling, transporting and preparing coal, is not of such a character as to require that they be put in a special class. It is quite true that there are dangers in this occupation, largely contributed to by carelessness or ignorance, but the work otherwise is much more attractive than that in the steel mills, the factories, the railroad yards, in the firing rooms of our ships, or on the farms, or in other occupations too numerous to mention. Generally the men go to work as they please. Most mines are well ventilated and afford comfortable working conditions, the workers suffer from neither the extreme heat of summer nor the cold blasts of winter. It is fortunate for the rest of society that this is true, and that men once engaged in the occupation of mining are loath to take up any other kind of labor; usually there is a surplus rather than a shortage of labor in most of the mining districts of the country.

The general public knows little of the varying quality of coals produced by mines in the same district; of the differing qualities in the various districts and states. For instance, in central Pennsylvania we find some of the lowest volatile smokeless coals of high steaming qualities that exist in the country. There are also veins of coal that are less valuable to the consumer; there are gas coal districts, coking coal districts and, farther west, the higher volatile steam coals, which for steaming purposes are not equal to coals lying on the eastern range of the coal fields.

There are differences in the thickness of the veins, in the character of the roof and in the amount of impurities; great quantities of water to be pumped out at some mines and comparatively little at others; the initial investment necessary in opening some mines differs from that in opening others; consequently, there is great variation in the cost of coal from different mines and in different districts.

The making of a wage scale to suit these varying conditions, and one that is equitable and fair to the miner, is one of the most difficult problems connected with the industry. Nevertheless, through time and experience, the wage scale, as a whole, has grown to balance these unequal conditions fairly well. The mines of the company that I represent, scattered, as they are, through three counties, show varying costs under the same wage scale for labor alone, the variations in cost sometimes running as high as $1 per ton. The miners will hardly believe this, and yet they must see part of the reason for this difference as they come in contact with these conditions daily. Competitive conditions soon bring the price of coal down to where the high-cost and poor-quality mines are put out of business, and a great many miners either have to remain idle for long periods, or remove to other places to seek employment.

### Only Specially Favored Mines Can Run

Today, in the bituminous coal regions, the only union mines that are able to run at all are those that have a superior quality of coal, or that have contracts made earlier in the year, which will soon expire, or railroad-owned mines that operate fairly continuously furnishing railroad fuel. Union mines depending upon industries for the sale of their coal are either being operated intermittently or remaining idle. The startling development within the last few day has been that cargoes

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of English coal have been offered in the New York and Boston markets at lower prices than coal can be produced for, even in the non-union mines in the Eastern coal regions. Although we hope that this does not indicate permanent competition, it is futile to hope for exports of coal until wages and transportation rates are materially reduced.

The other problems which affect both operator and miner at certain times are matters connected with transportation. Shortage of cars frequently occurs under active business conditions on certain railroads, whereas other railroads fully supply their mines. As a result of these shortages of cars, a system of private car ownership for the steel mills and for public utilities has developed, as well as for some of the large operating companies which supply special trade, and in times of traffic congestion private cars are moved in priority to the rest of the equipment. There is also the assigned car evil, which makes the problems of the small operator, as well as those of the larger operator who depends on railroad equipment for his output, very trying and expensive. This matter, which has been under constant discussion, is in abeyance at the moment because there is a surplus of cars for any mine that can get orders.

### [Relation of Operators to Miners]

We now come to the question that should have an immediate solution; *i.e.*, the present contract and future relationship of operators doing business with the miners' organization. The present contract with the union expires April 1; by or before that date, an adjustment of the present scale to a reasonable basis should be made. Unquestionably, much new construction and new development is postponed until the cost of coal is adjusted and railroad transportation rates revised and substantially reduced. The cost of coal is important to all industries and especially to the railroads, which consume about 28 per cent. of our annual production.

The history of the so-called collective bargaining movement, which originated in the West more than 25 years ago and was carried on through the organization known as the United Mine Workers of America, is too long a story to be told here. It is sufficient to say that the organization has grown through these years; today the United Mine Workers of America command about 60 or 65 per cent. of the labor employed in the soft coal mines of this country; the remaining labor, known as non-union, is engaged by operators who will have nothing to do, through contractual relationship, with the United Mine Workers of America. The collective bargaining theory of making wage scales and arranging working conditions has been developed by the unions into "collective threatening."

It must be admitted that 20 years ago conditions surrounding the bituminous industry of this country were deplorable, both for the miner and the operator, although this country was considered prosperous, compared with other countries at that period; wages in all lines of industry were more or less balanced and the cost of living was somewhat in line with the wages earned. Up to April 1, 1900, the highest wages paid men working by the day was $1.90; motormen were paid $1.75. From 1901 to 1903, the standard rate was $2.25; in 1904, it was $2.40; in 1905, it was reduced to $2.27; in 1907, it was restored to $2.40; in 1910 and 1911, it was $2.53, and it remained at that figure until April 1, 1916, when it was raised to $2.77. The war induced higher wages. The same class of labor was advanced in April, 1917, to $3.60. On Nov. 1, 1917, as a result of another demand on the part of the miners, wages were advanced to $5 a day. The national strike began Nov. 1, 1919 and lasted about six weeks, the men returning to work at a rate of $5.70 per day. On April 1, 1920, under the award of the Bituminous Coal Commission, the wage was advanced to $6. The miners, protesting against that decision, forced another increase on Aug. 15, 1920 to $7.50, so that we see, in 20 years, wages advanced from $1.90 per day to $7.50 per day. The rate for pick mining in the central Pennsylvania district went from 50 cents per ton in 1900 to $1.2803 a ton, the present rate. At these rates, the miners can, and do, earn from $150 to $350 per month. The miners' union takes credit for these advances while, as a matter of fact, they were the result of conditions which affected wages generally up to last year. These increased wages caused increased freight rates, which caused the cost of living to increase, and the vicious circle went on.

### Bituminous Coal Commission Award

The Bituminous Coal Commission appointed by the President to settle the 1919 strike left an award which was to last until April 1, 1922, with a peak of high wages in the mining industry never dreamed of before the war. When, somewhat over a year ago, the collapse in the whole economic structure began, there was violent resistance on the part of all organized labor against reduction of wages, but gradually the inexorable laws of supply and demand forced a readjustment in wages and costs and margins in many lines. The farmer, who had gone along with the tide of prosperity with high prices for wheat and corn, suddenly found that Europe could no longer buy his surplus and pay the high prices, and there was a gradual but sure decline in the prices of his product, so that today the farmer, who is the backbone of this country, is receiving less than pre-war prices for his product and is carrying a burden that is hard to bear. It is estimated that the buying power of the farmer for this year has decreased over eight billion dollars.

The Department of Agriculture has just issued a circular showing the relative fuel value of corn and coal. Already about 1,000,000 bushels of corn have

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been burned in Western towns because corn is cheaper than coal. Chicago grain men estimate that 25,000,000 bushels will be burned during the winter. What more striking example could be found of the results of one group of workers trying to pass the entire burden of readjustment to others? What more forcible example could be found to prove that the merchant who charges too much for his goods, or the laborer that demands excessive wage rates, simply drives himself out of business and leaves the field to more reasonable competitors?

The trade of the great mail-order houses has been greatly reduced because the farmers could not buy as usual; but while the farmer has had to absorb the shock of this economic change, organized labor has been stubbornly resisting and shutting its eyes to the cold facts, "passing the buck," compelling the farmer, the professional man, and all those with small incomes to carry the burden of the scale of wages.

The two notable forces that are blindly ignoring the economic situation and their duty to the public are union labor on the railroads and union labor represented by the United Mine Workers of America. The president of the United Mine Workers of America reiterates his statement that the present scale shall not be modified, and is supporting demands for a further increase in wages and changes in working conditions that will still further increase costs. The operators, not wishing to be in the position of having repudiated a contract, even if forced to do so through the breaking of a previous one and repeated violations of the present contract by the miners, have continued to live up to their agreement and have seen their trade disappear and many of their employees suffer through lack of work, all because the leaders of the employees are blinded by an exaggerated sense of their power, fighting among themselves for the political control of their organization, squabbling about broken contracts in Kansas and spending millions to raise armies to march through West Virginia and Alabama to extend their tyrannical control to all the coal fields of the United States.

### How Unions Destroyed Good Will

With a continuation of present practices and policies, the disruption of this organization is inevitable, and will come quickly. I consider it a duty for every operator familiar with the conditions to put this situation before the public for discussion, and when it is fully understood I have no fears about the fairness of its decision. Fortunately for this country, there are some miners and some operators who refuse to be led along the road to slavery. In the great coal fields of Irwin, Westmoreland, Connellsville, Latrobe, Johnstown, Greensburg, Black Lick, all of Somerset County, and many spots in Cambria County and other sections of Pennsylvania, together with a large percentage of West Virginia tonnage, miners have accepted an adjustment of their wage scale, are working under non-union conditions, getting fair wages, and are thus enabled to earn a decent living. The failure of the union to recognize changed conditions has destroyed the good will, trade and custom of the operators who have for years recognized the union; these union leaders may be described as the "blind leading the blind."

### The Abominable Check-off

There is an abominable system, called the "check-off," by which practically every man is compelled to belong to the union. We collect from every man the union dues and assessments and pay them over to the officials of the United Mine Workers of America; no other class of employers in the world has ever done such a thing. It is the opinion of government officials that this practice is illegal. The courts will decide, and it is hoped they will soon decide, so that the question will be settled definitely. Just stop for a moment to consider the absurdity of the views of the miners' organization in relation to the check-off. Only recently a Federal Court Judge at Indianapolis, Judge Anderson, rendered a temporary injunction restraining the operators from continuing to collect the check-off from union miners. This injunction was granted on an application of the Borderland Coal Co., representing a group of operators in West Virginia, who claimed that the operators and miners were engaged in a conspiracy and were using the money collected through the system of check-off in an unlawful manner to compel the operators of that district to recognize and deal with the union. Promptly upon the granting of the injunction, many miners went on strike, and it was understood that all of the union miners of the country were to be called out by the miners' organization on the ground that if the operators stopped collecting the dues, it would be a violation of an existing contract. The injunction granted did not change any part of the contract relating to wages or working conditions, but simply prevented the operator from collecting the miners' dues. The absurdity of a strike for this cause seems to me apparent. Nothing in the injunction prevented a miner who wished to pay his dues from paying them to the union officials. If the union leaders and miners planned deliberately to alienate public sympathy, they could not have found a better way than by striking on such an issue. A union that cannot exist by the voluntary payment of its dues by its members has no right to represent the working men of any industry. The shackles which this union has forged, on the miner, the operator and the public must be broken, and when I say this I do not say it with any thought that labor should be denied the right to organize. My contention is against the vicious practices and harmful influences which the policy of the United Mine Workers as now conducted will have upon the future of this nation.

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Non-union districts that are now operating are making contracts for next year and doing business with an assurance of no strikes, and are working on the basis of the scale paid up to 1919. Operators and miners working outside of contractual relationship with the United Mine Workers have made adjustments in their labor rates and costs which enable them to mine, on an average, 75 cents a ton less than the union operators are operating under today.

### Cost of New Developments

Capital required for the opening and equipment of new mines in our district, with proper housing facilities for employees, will amount to from $4 to $5 per ton of actual annual capacity; in other words, for a mine to produce 300,000 tons annually would require an investment of from $1,200,000 to $1,500,000. This figure does not include a cent for the value of the coal land, which varies greatly on account of difference in quality, accessibility, etc. Who would invest a dollar in such an enterprise under domination of the union as at present controlled? New development has stopped except by non-union operators.

As a result of the conditions under which we have been operating, our customers have grown to know that our performance is uncertain. We have to put in our contract a clause providing for immunity in case of strikes. Strikes are so frequent that we dare not take the risk of obligating ourselves to fill a contract because of the loss that might ensue. The result is that the consumers of coal in the markets to which we have access have been diverting their business to non-union operators and non-union districts. Many consumers have sympathy for the position in which we find ourselves. They tell us very plainly that they cannot renew relations with us until we get not only our costs and prices adjusted to a fairly competitive basis, but that we must give a better assurance, no matter what the price may be, that they will get the coal when they want it.

I have seen wise leaders of labor organizations in my time, but never have I seen such harmful leadership of organized labor as we have to deal with today in the United Mine Workers of America. I am not mincing the facts. It may be that a strike will ensue; in all probability it will. We should be left to fight it out, because the fight we are making and the arguments I am making today are principally in the interest of the general public, as well as in the interests of the operators and the miners. It is well for people to "put their houses in order" because the conflict is bound to come; in my judgment, there is no avoiding it. It is to be hoped that there will be no government interference or compromises and that when it is settled, the leaders of our industry—not the small-minded men, but the men of experience, the big broad-minded men, men who have sympathy—will be willing to sit down and make a scale with a rate of wages that is fair and decent and comparable with the rates paid in other districts. We do not believe that the miners should be pauperized. They are an essential part of the working force, necessary to keep our present day civilization going, and they must not be treated as slaves. I would be one of the first to resist going below what is fair and just. The 1919 scale of wages, which gives a man $5 a day, is fair compared with the present cost of living. It should not be more; in my judgment, it should not be less. Any compromise above that figure would only postpone the day when normal business conditions will again prevail.

I have just read President Harding's address to Congress, in which he treats the union labor problem and its relation to the public welfare in part as follows:

> The right of labor to organize is just as fundamental and necessary as is the right of capital to organize. The right of labor to negotiate, to deal with and solve its particular problems in an organized way, through its chosen agents, is just as essential as is the right of capital to organize.
>
> Just as it is not desirable that a corporation shall be allowed to impose undue exactions upon the public, so it is not desirable that a labor organization shall be permitted to exact unfair terms of employment or subject the public to actual distresses in order to enforce its terms. Just as we are earnestly seeking for procedures whereby to adjust and settle political differences between nations without resort to war, so we may look about for means to settle the differences between organized capital and organized labor without resort to those forms of warfare which we recognize under the names of strikes, lock-outs, boycotts and the like.

It seems to me these principles are fundamental and that this is the psychological moment for giving them serious consideration with a view to securing legislation based on them, in order that the liberty guaranteed by our Constitution shall be preserved for the people of this nation as a whole.

### Miners' Wages and Railroad Rates

A proper adjustment of miners' wages will help the railroads to lower their rates, and railroad rates must be reduced. We are paying twice as much for the hauling of a ton of coal from our fields today as we did in 1915; the rate to tidewater was then $1.55; it is now $3.11. Every manufacturer throughout the East who is endeavoring to lower his cost is clamoring for lower freight rates. His customers are demanding lower costs. The professional man, the salaried man and people with small incomes have long been subjected to extortionate prices resulting from war conditions. This group will not tolerate having the operators enter into any combination or any agreement which tends to keep the price of coal on a war basis. With $5 a day for day men, and with miners able to average $7.50, they will be earning nearly double what they earned up to April 1, 1915, and this will be nearly double the rate paid for common labor in the steel mills of the country.

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# Medal Awarded to Charles Warren Goodale for Safety and Welfare Work

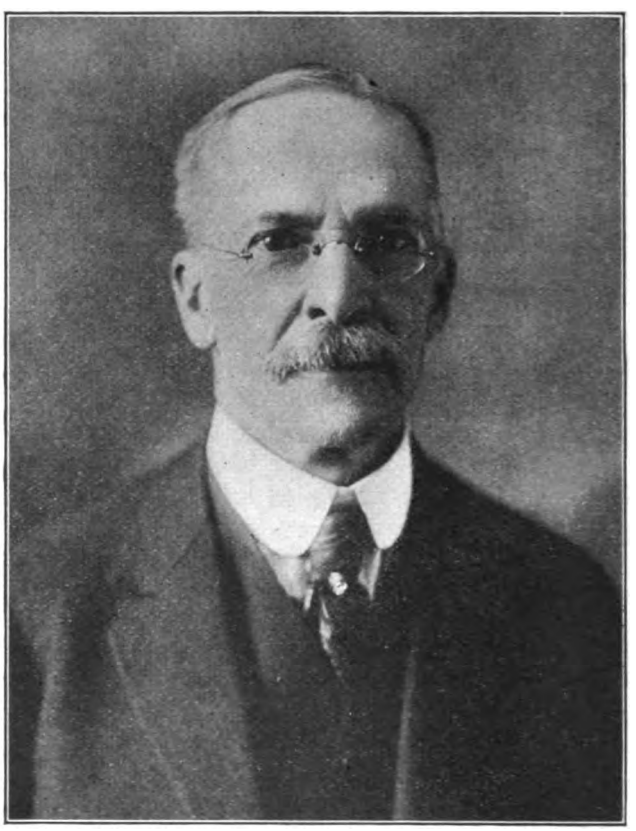
THE gold medal of the Mining and Metallurgical Society of America was presented, on Jan. 10, 1922, to Charles Warren Goodale, "for signal services in furthering the welfare and safety of workers in the mining and metallurgical industries of America." The presentation was made by Dr. J. E. Spurr, president of the Society for the year 1921, at the annual meeting held in New York City.

Dr. Van H. Manning, formerly director of the U. S. Bureau of Mines, made the first address. Toward the close of his brief speech, he said, "It has happily been suggested, 'Let us balance our praise of war heroes by pausing to honor a hero of peace.' We have with us tonight a man who has been a leader and inspirer of thousands of his contemporaries. . . . His zeal in the great work of increasing the safety of men engaged in mining and metallurgical operations has become an obsession with him. . . . That he has been successful is evidenced by the great work, of which I have personal and intimate knowledge, done by him in connection with the Anaconda Copper Mining Co. and its subsidiaries."

Dr. J. F. Kemp gave a brief sketch of Mr. Goodale's career, in the course of which he said, in speaking of the consolidation of the Boston and Montana, the Anaconda, and smaller companies, "at the same time electric current was introduced for haulage in the mines and on the surface for the running of air compressors and the hoisting of the cage. . . . We can see that there was great danger to the miner and that safety first became a very important feature of the work. . . .

"As time has passed, we find all the southeastern peoples of Europe, many of them unable to speak English, employed in the mines. It becomes a very difficult problem to maintain proper precautions for safety with so diverse a series of people and with such careless men. In later years, all these various lines of safety first have fallen to Mr. Goodale and very successfully and admirably has he carried out the heavy responsibility of his position. Within the last year, with all the large mines practically idle and only the smaller silver mines in operation, with fifteen or twenty thousand men thrown out of work, with families necessarily in need, the welfare work has become an operation of the very first magnitude. . . . The Society has never taken a more admirable step than when it decided to confer its medal upon Charles W. Goodale, the best loved man in Butte."

Mr. Goodale was a member of the class of 1875 of the Massachusetts Institute of Technology. He began his professional work in 1876, with the Boston & Colorado Smelting Co. In 1880, he became superintendent and manager of the Boston & Arizona Smelting & Reduction Co. at Tombstone; and five years later went to Butte to be superintendent of the Colorado Smelting & Mining Co. In 1898, he became affiliated with the Boston & Montana Consolidated Copper & Silver Mining Co.,



CHARLES WARREN GOODALE.

as superintendent of the smelter at Great Falls; three years later he became assistant manager, and in 1912, was made manager.

Since the Boston & Montana was merged with the Anaconda Copper Mining Co., Mr. Goodale has been chairman of the Bureau of Safety of the company. He will present at the New York meeting of the Institute, Feb. 20–23, a paper by himself and Mr. Boardman (see page 38) which outlines the work of the Bureau of Safety, but tells only by implication of his own share in the tremendous task.

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# American Engineering Council's First Annual Meeting

By EDWIN LUDLOW

President of American Institute of Mining and Metallurgical Engineers

ROUNDING out a year of improved organization, substantial accomplishment and strengthened purpose, the American Engineering Council of the Federated American Engineering Societies held its first annual meeting at the Cosmos Club, Washington, Jan. 5 and 6, Dean Mortimer E. Cooley of the University of Michigan, president of the Council, presiding. Officers were chosen, the work of the past year was reviewed and discussed, action was taken on important matters of public and technical service, new financial arrangements were put into effect, committees were named, new policies were sanctioned and old ones reshaped, and a broad and definite program was outlined for the next twelve months.

A leading event of the meeting was a dinner in honor of Herbert Hoover, who, addressing the members of the Council and their guests at the University Club, praised the work of the Committee on Elimination of Waste in Industry as a great and lasting public service, pointed the way for new engineering effort in the public interest, and expressed renewed devotion to the ideals of the Council. Resolutions of appreciation of the service of the Secretary of Commerce were presented to Mr. Hoover.

## Long Discussion on Licensing

The council engaged in a long discussion of the question: Does the American Engineering Council approve or disapprove of the principle of licensing or registering engineers? Prof. Donald Derickson of Louisiana was a leader of the affirmative side, asserting that the experience of his state had been such as to justify the conclusion that the licensing statute had been beneficial alike to the public and the engineer. Gano Dunn, of New York, in a spirited speech opposed action by the Council at this time, saying that the whole question should be carefully studied before a definite policy was adopted. Maj. F. J. Miller of New York, and Dean Perley F. Walker of the University of Kansas supported this view. Philip N. Moore, of St. Louis, speaking for the mining engineers, stated that as a group they were opposed to licensing and asked that this matter be not again referred to a committee but that Council put itself on record as opposed or in favor of licensing. Gardner Williams, of Detroit, then made a strong plea for licensing and begged that the question should not come to a final vote, as it would appear that any action would be by only a small majority. It was then voted to lay this question on the table.

At the meeting of the Executive Committee following the Council meeting, Dean Cooley appointed a committee of three to examine further into the subject and report. This committee consists of Gardner Williams of Detroit, P. N. Moore of St. Louis, and A. S. Dwight of New York, as chairman.

## Encouraging Reports on Outlook

Dean Cooley, in opening the sessions, declared his confidence in the future of the Council and outlined generally his plans for more effective organization to be carried out in coöperation with the executive secretary, L. W. Wallace. President Cooley will soon start on a tour of the South and Southwest, to further the work of organization.

Encouraging reports of the outlook for accretions to membership were reported to the Council. The secretary's report showed that on Jan. 1, 1921, the membership of the society was composed of 6 national and 14 state and local societies, a total of 20. On Dec. 31, 1921, there were 8 national and 20 state and local societies, a gain of 8 member societies representing 1414 member engineers.

Conditions in the mining industry, as stated by Edwin T. Ludlow, president of the American Institute of Mining and Metallurgical Engineers, and Col. Arthur S. Dwight, were responsible for a reduced contribution by the Institute to the Council for the coming year. As a consequence, the assessments levied upon the other member societies were cut down proportionately. This was accomplished by constitutional amendment. Both Mr. Ludlow and Colonel Dwight assured the Council that the Institute was warmly in sympathy with the Federated, with which it was anxious to go forward. Sharp reductions in the budget were thus made necessary, and, though the Council begins the year with a scarcity of funds, assurances were given that if the Mining Engineers can, either by increased appropriation or by personal subscription of its members make up its pro rata share of the full assessment, then the other societies will also contribute their full proportion and enable American Engineering Council to continue its work.

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The balloting for officers resulted in the re-election as vice-presidents of Dexter S. Kimball, Dean of the College of Engineering, Cornell University, and J. Parke Channing of New York. W. W. Varney of New York was again chosen treasurer. L. W. Wallace was re-elected executive secretary by unanimous action of the Executive Board.

The Council voted to coöperate in the movement to prepare for cyclical industrial depressions and unemployment by resort to public works projects. On this subject, the Council received a proposal from Mr. Hoover, and it was decided to open conferences with him to ascertain in what way the Council could best provide effective aid.

Considerable discussion was provoked by the plan to establish a Federated journal which would be sent to every engineer represented by the Federated. The Publicity Committee made no recommendations and the Council took no definite action. It was generally agreed that some such contact should be established between the Federated and its enrolled membership, but there was sharp diversity of opinion as to its form.

New representatives on the Council were announced as follows: American Society of Mechanical Engineers: Francis Blossom, Charles A. Booth, Gano Dunn, H. H. Esselstyn, W. S. Lee, I. E. Moultrop, John H. Stevens, A. E. Walden; Society of Industrial Engineers: Prof. Joseph W. Roe; American Institute of Mining and Metallurgical Engineers: C. H. MacDowell (succeeding J. W. Richards); Louisiana Engineering Society: Prof. Donald Derickson; Iowa Engineering Society: Lloyd B. Canfield; Duluth Engineers Club: W. H. Hoyt; Milwaukee Engineering Society: Albert Blatz, Jr.

The Executive Board of the Council for 1922 is made up as follows: H. E. Howe, Washington, American Institute of Chemical Engineers; Prof. C. F. Scott of Yale, L. B. Stilwell and Calvert Townley of New York, J. H. Finney of Washington, William McClellan of Philadelphia, and L. F. Morehouse of New York, representing the American Institute of Electrical Engineers; J. Parke Channing and A. S. Dwight of New York, Charles H. MacDowell of Chicago and Philip N. Moore of St. Louis, the American Institute of Mining and Metallurgical Engineers; L. P. Alford of New York, E. S. Carman of Cleveland, Dean D. S. Kimball of Cornell, Prof. A. M. Greene of Troy, Dean Perley F. Walker of Kansas, W. S. Lee of New York, Dean M. E. Cooley of Michigan, American Society of Mechanical Engineers; Prof. Joseph W. Roe of New York, Society of Industrial Engineers; Morris L. Cooke, Philadelphia, Taylor Society; W. E. Rolfe, Associated Engineering Societies of St. Louis, W. W. Varney, Baltimore.

Regional Directors chosen for 1922 are: District No. 1 W. B. Powell, St. Louis; District No. 2, Gardner S. Williams, Ann Arbor, Mich.; District No. 4, W. J. Fisher, York, Pa.; District No. 5, Paul Wright, Birmingham, Ala.; District No. 6, Lloyd B. Smith, Topeka, Kans.; District No. 7, O. H. Koch, Dallas, Tex.

The request of Dr. B. Stepanek, the Czecho-Croat Minister to the United States, that his government be given copyright privileges on "Waste in Industry" has been approved by the Committee on Procedure. The translation has been made and the waste report will be widely circulated in that republic. Increasing interest in the waste report was reported. The first edition of 2000 copies has been exhausted and preparations are being made for the second edition. Inquiries concerning the work of the Council's Committee on the Elimination of Waste in Industry are coming in from all over the world and numerous engineering, civic and economic organizations have held meetings to discuss its findings.

The work of the committee on employment, which was mapping plans for a paid employment service, has been delayed owing to the illness of the chairman, Morris L. Cooke of Philadelphia.

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## Zirconium, the Mystery Metal

ON ACCOUNT of various properties and uses that have been attributed to it, zirconium has at times been styled "the mystery metal." Its compounds have numerous important uses and more uses will doubtless be found. Investigations in recent years have indicated that sintered or coherent zirconium metal is resistive to acids and that it can be used for electrodes. The salts have been used in the textile industry as mordants and also for weighting silk.

Zirkite firebrick is used for furnace lining as well as for other purposes where a refractory having a low coefficient of expansion, high melting point, and maximum resistance to slag corrosion is demanded. Although zirconium oxide has not proved satisfactory for gas mantles nor for arc lamps, it has been used for polishing powders, insulators for both heat and electricity, and with fair success in the Nernst lamp. Being absolutely non-poisonous, zirconium oxide is finding a use in paints and lacquers, where its resistivity to physical and chemical agents is proving highly valuable. As an abrasive, zirconia, zirconium silicide, and zirconium carbide are suggested for a variety of uses, the carbide particularly as a substitute for the diamond in cutting glass. Zirconium oxide, because of its non-toxic nature, is used in place of bismuth nitrate or carbonate in Rœntgen-therapy. Crucibles prepared from zirconium oxide have proved superior for high-temperature work to any crucibles procured on the market.

The results of the investigations of the Bureau of Mines are available in Bulletin 186, "Investigations of zirconium with especial reference to the metal and oxide," by J. W. Marden and M. N. Rich, which is distributed by the Superintendent of Documents, Washington, D. C., at a price of 25 cents.

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# Block-signal and Dispatching Systems in Metal Mines*

By R. T. MURRILL

Safety Engineer, Inspiration Consolidated Copper Co., Inspiration, Ariz.

BLOCK-SIGNAL and dispatching systems have been in use on surface railways for years, but only recently have they been applied to underground mining conditions. Formerly, all ore was moved underground by hand tramming; the surface openings were numerous and fairly close to the ore being mined. As the tramming distances increased, animals were brought into service. Then came the locomotive, and since its introduction, haulage lines have gradually been reduced to fewer levels and to fewer surface openings until more than 20,000 tons are being handled daily on one level in some of the larger mines. Under these conditions many trains must use the same tracks, and signal systems have become necessary.

In some cases it has been found more advantageous to use train dispatchers than to install signal devices. The dispatcher may be simply a flagman at a busy point or he may have mechanical signals to operate at more distant points. At the Inspiration mine, Inspiration, Ariz., the station is equipped with a switch-control board, whereby the dispatcher throws electrically all track switches in a certain block, which gives him complete control over all trains passing through that

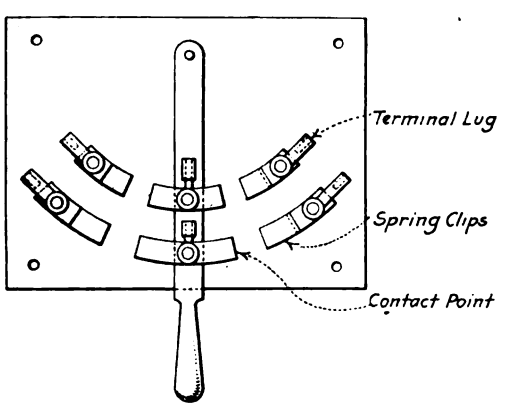


FIG. 1.—TYPICAL SWITCH FOR MANUAL OPERATION.

block. In a few cases, dispatcher stations are established in connection with a signal system.

Signal systems vary from many simple forms to the highly complicated electrically operated block-signal systems. The simplest form is used at shaft stations or at points where a main line branches, a short distance from the shaft station, where loaded trains are brought in on the various branches. However, the usual problem is a long main line with branches coming in at various places, but where the presence of trains in limited portions only need be indicated at one time. A series of blocks is therefore laid out, and at the end of each block, or wherever branches enter a block, a signal shows whether or not a train is in that section of the track. Block signals vary greatly in arrangement and apparatus employed but divide themselves into two general classes, manual and automatic.

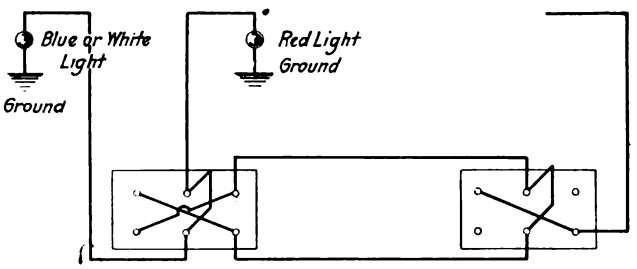


FIG. 2.—WIRING DIAGRAM FOR A SIMPLE MANUAL BLOCK.

## MANUAL BLOCK SIGNALS

In the manual block system, the signals are operated or controlled by hand. The simplest form is obtained by running an extra electric circuit alongside the tracks, and connecting to this red lights placed at the ends of the blocks, at curves, branch lines, etc. Whenever a train enters a block, the driver or trainman throws an electric switch nearby, lighting the red lamps along the block. When a train leaves the block, the switch at that point is thrown, cutting out the red and turning on the white lights. Many forms of switches are in use. The most common, and one of the most practical, is that of the type shown in Fig. 1; the latest designs are housed so that connections and contacts are not exposed. The switch is generally placed on a post beside the track where the driver can reach it without leaving his seat. A wiring diagram for a simple manual block using this switch is shown in Fig. 2.

## AUTOMATIC BLOCK SIGNALS

In the general acceptance of the term, an automatic block system is one in which each block is operated by power, usually electric, and is controlled by one or more track circuits, so that it is automatically set at stop when a train enters the block and remains so until the block is clear. The entrance of a train into a block, at

*Read at Tenth Annual Congress, National Safety Council, Boston, Sept. 26 to 30, 1921. To be presented at February Meeting A. I. M. E. for discussion.

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either end or at an intermediate point, the presence of a car in the block or inside certain limits of the turnouts, or the setting of the track switch for a turnout, will cause the display of a stop signal, which will be displayed until the switch is in proper position and every part of the track included in the circuit is clear and safe for passage.

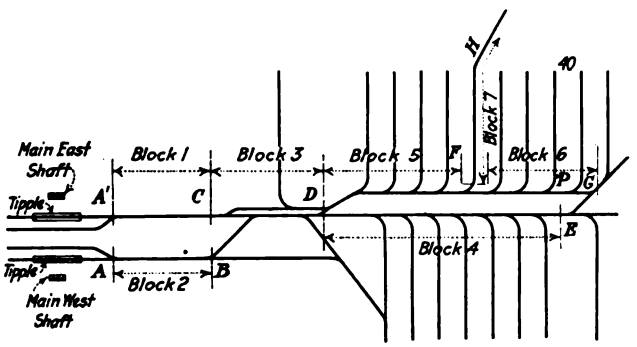


FIG. 3.—PARTIAL PLAN OF 600-LEVEL SHOWING GENERAL LOCATION OF BLOCKS.

All underground automatic systems are so arranged that when necessary the signals may be passed when in the stop position. A train may proceed, when it is deemed advisable, by sending a flagman a certain distance ahead. The trains usually travel at a speed that makes it possible to stop quickly.

Signal lights are generally operated through track circuits carrying low-tension currents, on account of imperfect insulation. At each rail joint, wire bonds secure electrical continuity and insulating joints are placed in the track at the end of each block section. Control by track circuits is the only system today considered by experts to be fundamentally safe, as it gives each train the means of maintaining at all times its own protection.

## THE INSPIRATION SYSTEM

At the Inspiration mine of the Inspiration Consolidated Copper Co., an automatic block-signal and dispatcher system is in operation on the 600-ft. level. This system is an adaptation of the standard equipment used for high-speed surface railway traffic, the equipment being furnished by the General Railway Signal Co., Rochester, N. Y.

The trains consist of 5-ton ore cars drawn by compressed-air locomotives, which have a maximum speed of 10 to 12 mi. per hr. but which are limited to 8 mi. per hr. on tangents and to 5 mi. per hr. on curves or when passing over switches that face an approaching train. The average mine haul is 0.475 mi. About 217 round trips per day are made to the tipples at the main shafts and about 30 trips on the level with waste and supplies, giving a total of 247 train trips per day. About 232 of these round trips, or 464 single trips, pass one point *D*, Fig. 3, but 496 trips have passed it in one day. To handle this traffic properly, the automatic signal system was installed with a dispatcher station at the busy point.

The level is divided into a number of blocks and signal lights have been placed at the ends of each block and at other prominent points on the main lines, also on the curves of all turnouts from the main lines, as shown at point *P*. These lights are operated automatically, by the passing of a train or the throwing of a track switch level. A red light signifies danger and a blue light, safety; a green light indicates that the track is clear on the siding or turnout to which the switch bearing it leads.

The lamps on the main line always show blue when the tracks are clear. The lamps on the curves *P* of the turnouts of the loading drifts show red until the track switch to the main line is thrown, when they show blue if the main line is clear. Red lights always show when trains or cars are on the tracks, when track switches are open or split, and when electrical connections are broken. Trains are permitted to pass red lights only after an investigation as to the cause and then only if preceded by a flagman. No light has the same significance as a red light and trainmen must stop until passage is proved to be safe; then the train must proceed as when a danger signal is displayed.

Each of the signals consists of two 110-volt, 10-watt, 2-candlepower lamps in multiple. These lamps are mounted in porcelain receptacles in small cast-iron boxes. The boxes are equipped with 4½-in. diameter lenses and with guides that slip over brackets attached to caps or posts of drift sets.

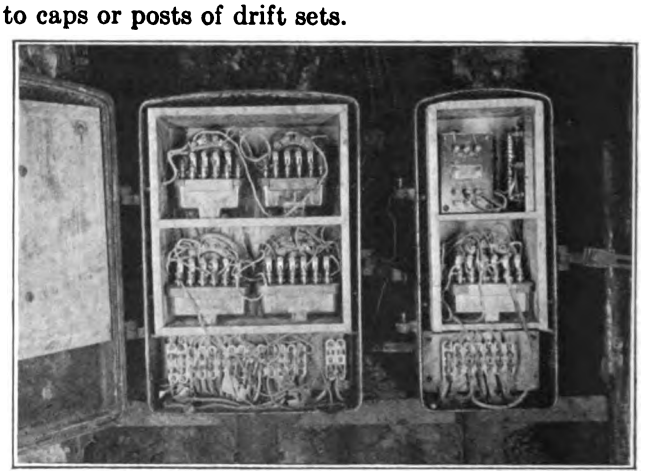

FIG. 4.—TRACK RELAYS AND TRANSFORMER.

The track circuit is the heart of the system, as it furnishes the power necessary for operating the signals; 25-cycle alternating current is used for this purpose. The line current as received from the mine substation is 110-volt; track transformers in each block operate upon 110-volt primary and give almost any voltage up to 14 volts on the secondary. Rails, under the best conditions, make very inefficient transmission lines; so relays are used. The relay controls, through its contact points, another circuit supplying the power to operate the signals. The relays and track transformers are housed in cast-iron boxes, as shown in Fig. 4. A diagram of the track wiring for a single turnout is shown in Fig. 5.

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An important feature of the installation is the track switch-circuit controller, which causes the proper signals to assume the danger position when a switch is open or split. These controllers are attached by adjustable rods to all switch points and contacts are arranged to make or break when the switch points are moved ¼

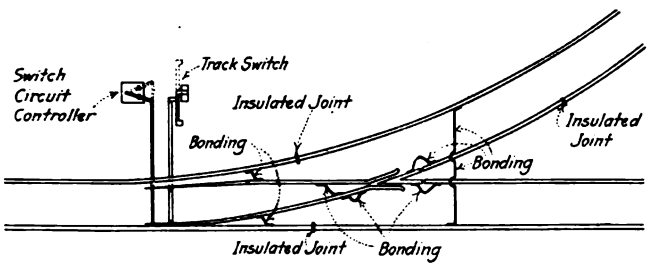


FIG. 5.—TYPICAL TRACK WIRING AT A TURNOUT FOR AUTOMATIC BLOCK.

in. from the closed position. One switch box, shown in Fig. 6, is placed at each switch.

At the dispatching station *D*, Fig. 3, the key point of the haulage system, there is a switch-interlocking machine, Fig. 7, equipped with sixteen levers, each of which controls the mechanism for operating a track switch. This mechanism consists of a series-wound direct-current motor connected through a shafting and friction clutch to a gear arrangement for throwing the switch. The mechanical operation of the track switch also operates the signals of the block-signal system. In addition, the dispatcher has independent means of signaling the trains when he wishes them to proceed or stop.

FIG. 6.—TRACK SWITCH-CIRCUIT CONTROLLER.

Indication is given on the board, when a track switch is not thrown completely and locked in position; and there is an arrangement whereby a switch cannot be moved under a passing train. In case of a wreck or other emergency the switch may be thrown by unlocking the control lever. A 1 by 1½-in. piece of glass, bearing the switch number, is placed above each lever; when a train is within a certain distance of the switch, a small electric lamp behind this glass is lighted. The dispatcher has direct telephone connection with the tipple station and with switch *B*, which cannot be seen

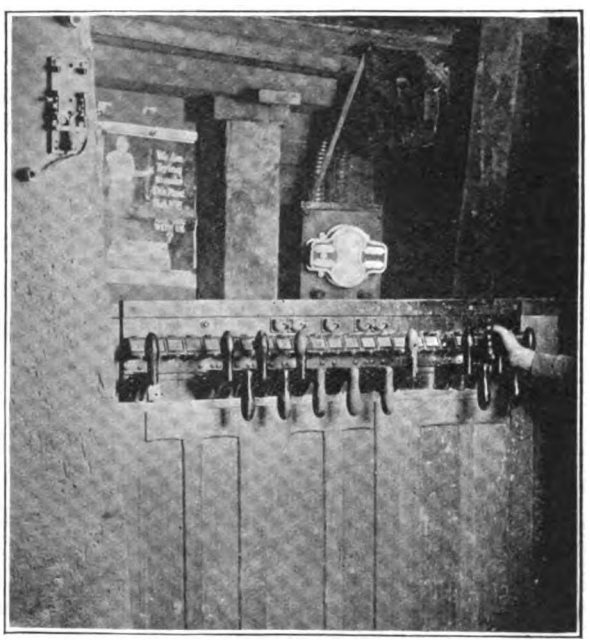

FIG. 7.—INTERLOCKING BOARD.

from his station. The switch-throwing mechanism is shown in Fig. 8.

To show the operation of the system, suppose that a train is to be taken from a loading drift, No. 40, to one of the tipples at the main shafts. As the train approaches the entrance to the main line, a flagman runs ahead and, if the main line appears to be clear in that block, throws the switch; if the red light at *P* changes to blue, the train proceeds. If the red light continues to show, it indicates that block 6 is not clear and the train must wait behind the signal *P* until the block is cleared. Before the train can continue into block 5, a blue light must show at point *F*, and before it goes to block 3 a signal must be received from the dispatcher at *D* in addition to the block signal at that point. The dispatcher determines to which tipple the train will be sent and gives it the right of way by throwing the proper switches.

A train going back follows a similar procedure. For instance, a train leaving the main west tipple must have a clear signal at *A* before it can leave the tipple station. At *B*, it must await a signal from the dispatcher before it rounds the curve into block 3. The dispatcher must throw the switch at *B*, from his board, which also changes the block signal at *B* to safety, before giving the signal to proceed. The dispatcher then sends the train into block 4 or 5, as he desires.

Block 7, Fig. 3, of the system is wired to give what railways call an "absolute permissive block." By this

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is meant that following trains are permitted to enter an occupied block but they must be prepared to stop on a flagging signal, while opposing trains are given an absolute indication to stop. This block is on a turnout leading to several loading drifts. At the entrance *F* to the block three signal lamps are placed in a row but only three indications are given by the lamps. The red light alone indicates danger and the blue light indicates that the track is clear. The red and green together indicate that the track is occupied and that a following train may enter but must be prepared to stop at any time. This permits a number of trains to follow one another into the block and thereby increase the capacity of that section of track.

### Requisites of Block-signal Systems

All block-signal systems must meet a few fundamental requirements. In the first place a system must be simple and easily understood by the train crew. Mine-haulage conditions differ much from the surface-haulage lines. A railway locomotive driver reaches

Fig. 8.—Switch-throwing mechanism.

his position only after many years of service and that often on the same road; in a mine, the train crews change more frequently and men from almost any position may soon learn how to operate a mine motor. Besides, a train in a mine usually goes backwards as much as forwards, so the rear flagman also must watch the signals. The rear flagman may or may not have worked on trains before, as it is sometimes necessary to use men from other parts of the mine as flagmen. The signal system must therefore be one that the trainmen can comprehend quickly. Indications that trains are in neighboring blocks are usually confusing and often unnecessary; it is best to have each block complete in itself, if possible.

There must be a positive signal for proceeding, not the mere absence of a signal. Then, if a light goes out, a danger signal will not be accidentally changed to a clear signal. The absence of a signal should have the same effect as a danger indication. Blue or green lights should be used as signals for proceeding, rather than white lights. The breaking of a red lens will not then change a signal from stop to proceed or a neighboring white light will not be mistaken for a signal light. In manual block systems it has been common practice to use only red and white lights, but this practice should be discouraged.

The choice of a block-signal system for any particular mine depends largely on the volume of traffic to be handled on the levels. Mines having many haulage levels have usually only a few trains to a level and find manual operation of the blocks adequate. Layouts of many levels can be arranged with run-arounds and with one-way traffic on certain lines, so that manual systems are permissible. Mines having a congested mining area and handling large tonnages of ore and waste, however, find the automatic systems a necessity.

There are many forms of block signals between the simple block system described and the Inspiration automatic system. An interesting one is used with trolley locomotives at the Arizona Copper Co. A wire, strung parallel to the trolley wire, was connected to lamps at each end of a block and grounded. Current was furnished to the lamps by the pantagraph collector bridging the trolley wire and the signal wire. The indication of a locomotive in the block is positive, but the presence of cars without a locomotive is not indicated. Its principal feature is the low installation cost.

### Advantages of Different Systems

Each signal system has its particular advantages. The manual method has the advantage of low cost of installation and maintenance, and its blocks can quickly and easily be changed or extended. The automatic (track-circuit) method has the especial advantage of eliminating the human factor in signaling, as far as possible. The use of track-circuit control of the signals makes the train at all times active in maintaining its own control. J. P. Coleman, in the Third Annual Report of the Block Signal and Train Control Board of the Interstate Commerce Commission, says:

> Perhaps no single invention in the history of the development of railway transportation has contributed more toward safety and dispatch in that field than the track circuit. By this invention, simple in itself, the foundation was obtained for the development of practically every one of the intricate systems of railway block signaling in use today wherein the train is, under all conditions, continuously active in maintaining its own protection. In other words, the track circuit is today the only medium recognized as fundamentally safe by experts in railway signaling whereby a train or any part thereof may retain continuous and direct control of a block signal while occupying any portion of the track guarded by the signal.

Both direct and alternating currents are used for track circuits but the alternating-current system gives more economical operation and maintenance. An alternating-current track circuit is obligatory in mines using trolley locomotives in order to prevent the track relays from operating on the traction current or stray currents.

The development of railway signaling in general has called for much study and a large money outlay. The block-signal system was introduced primarily for safety, but where trains are frequent it has become an element of economy.

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# Fire Prevention and Fighting in Metal Mines*

By H. M. WOLFLIN
Superintendent of Safety, Industrial Accident Commission of California

SOMEWHAT more than a year ago the writer collected some extensive notes on metal-mine fires and a paper on metal-mine fire prevention and fighting, a summary of these notes, was hastily prepared, with the assistance of G. Chester Brown, chief mining engineer, Industrial Accident Commission for the National Safety Council meeting. This summary, which is admittedly incomplete, is submitted in the hope that it will evoke some discussion that may result in a reduction in metal-mine fire hazards, somewhere along the line. To accomplish such a reduction does not require the application of complicated scientific data. The use of just a little care, a small amount of thoughtfulness and a bit of common sense will work wonders.

## Underground Fire Fighting

There may be some interest in a short list of conclusions of a rather general nature that were reached in connection with some recent mine-fire fighting operations. No effort has been made to cover the field; the items have been jotted down loosely, and very hastily, in the order in which they occurred to the writer. Originality is claimed for only a few of them.

1. Temperature readings and analyses of mine-air samples, systematically taken, are invaluable aids to effective metal-mine fire fighting and recovery operations. The analysis of the return-air samples frequently gives a surprisingly accurate indication of conditions existing underground.

2. Employees must be thoroughly trained in the use of mine rescue apparatus, because a relatively slight difference in the amount of training makes a vast difference in the amount of work they can perform under oxygen. In general, slender, wiry men make better apparatus men than those of heavy, more muscular physique, although there are frequent exceptions to any such general statement.

3. Surprisingly high temperatures, up to 165° F. or 170° F. can be endured for short periods by wearers of mine rescue apparatus if the air is dry, but lower temperatures, 135° to 140° F. are almost unbearable if the air is very moist.

4. There is likely to be an urgent need of mine rescue equipment and thoroughly trained men familiar with the mine workings at every timbered metal mine.

5. The choice of fresh-air bases, when performing mine rescue work, is very important, for it must be certain that the air is not contaminated by gases from the fire. If natural ventilation is depended upon, the air current must be watched with care to see that it does not reverse.

6. The strictest discipline is necessary to prevent men who are returning from the fire zone from removing their apparatus before they reach the fresh air base.

7. Mechanical ventilation greatly simplifies metal-mine fire fighting operations and increases the safety of the men engaged in the work.

8. The products of combustion from a fire diffuse with great facility through closely filled ground for distances that are surprising. This is true even when differences in atmospheric pressure are relatively slight between the burning workings and those that are not affected by flames. Bulkheads in filled ground are absolutely useless, therefore, for fire-fighting purposes, as a general rule.

9. It is advisable to have bulkheads continuously and frequently patrolled even though they have been recently completed and carefully inspected.

10. If moist clay can be secured in sacks (or dry clay sacked and moistened) one of the quickest methods of building a satisfactory bulkhead in a drift or cross cut is to put up a wall or brattice of 2 by 12-in. or 2 by 6-in. boards nailed to posts or stulls and fitted as closely as possible at the ends, then to nail two or more 3 by 3, or 4 by 4-in. strips on the outside and add another board wall, fastened to the strips, moist clay being tamped between the walls as the outside wall is put up. The outside wall should be calked carefully with clay, especially around the edge and at the top and bottom.

11. When bulkheading timber drifts or cross cuts, a tight seal rarely, if ever, can be made unless all lagging is cut and a section removed, and all loose rock and dirt taken down before the bulkhead is started.

12. Close observation of both candle and canary birds is necessary if men working without mine rescue apparatus in the fire zone are to be spared the nausea and excruciating headache of slight CO poisoning. If men working hard are using a bird to warn them of carbon monoxide, the bird should be kept moving enough to make it pant, otherwise men may be affected before the bird shows distress.

13. The resistance of individuals to low percentages of CO varies between relatively wide limits. Fre-

*Presented at the Mining Section of the National Safety Council, Boston Meeting, Sept. 27-30, 1921.

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quently more robust individuals with large lung capacities are the first to succumb.

14. Timber fires burn and spread more rapidly than coal fires and conversely die down and cool off more rapidly when the air supply is checked. They are extremely deceptive and likely to blaze up when it is thought that they have been extinguished.

15. When the fresh-air supply is restricted, an underground fire tends to travel against the air current, even though the current may be coming from below; if the air is moving at higher velocities, so that the supply is more plentiful, the fire may travel both ways. If the draft is extremely strong, the fire will probably travel with it.

16. Reliable means of signalling from skip or cage should be maintained at all times during fire-fighting operations in shaft mines. The method of signalling becomes extremely important when it is necessary to ride skip or cage in irrespirable atmospheres.

17. The presence of carbon monoxide in the mine air indicates an active fire (except for the relatively small amounts of CO generated in blasting operations), but the absence of carbon monoxide is not a positive indication that the fire has been extinguished.

18. Finally, it is pointed out that effective organization of fire-fighting forces is of paramount importance. Men, equipment and supplies mean nothing, can accomplish nothing, without thorough organization and the strictest discipline. This is regraded as the most important of all the suggestions and observations.

### Prevention and Protection

In connection with the broad problem of metal-mine fire prevention and protection, the following somewhat general observations and suggestions may be of passing interest:

1. All wooden headframes, wooden structures and supplies of inflammable materials near any mine entrance should be removed or replaced by fireproof structures. If this can not be done, at least such wooden structures should be made as nearly fireproof as possible by means of gunite or some other equally efficient method. All planked floors around the collar of the shaft or at the portal should be removed and non-inflammable construction substituted.

2. Mine timbers should not be piled in the immediate vicinity of the collar of the shaft or at the portal of an adit or a tunnel.

3. Proper storage of dynamite in fireproof places is essential. Boxes of dynamite should not be left near the collar of the shaft or at the portal of an adit or tunnel.

4. Removal of all accumulation of inflammable waste material and refuse from the mine or near the vicinity of the collar of the shaft is important.

5. Proper storage of gasoline or oil at an adequate distance from the mine entrance should receive attention.

6. If underground pump stations or hoist stations need support, steel and concrete or at least gunited timber should be used.

7. All oily waste should be removed promptly from the vicinity of pump or hoist stations and pending removal should be kept in metal receptacles carefully placed and protected.

8. Electrical apparatus, especially wiring and transformers, should be properly installed and carefully protected. All electrical equipment should be placed in fireproof stations.

9. The installing of adequate underground and surface fire-fighting equipment, and the organization of fire-fighting crews are worthy of the most active attention.

10. Fire drills on the surface and underground should be conducted frequently and thoroughly. Those commonly conducted underground are pitifully inadequate and generally come at such long intervals and involve so few men that they are almost worthless. How many men in the average metal mines have an adequate knowledge of the location of escapeways and fire-fighting equipment? How many receive intelligible instruction in these important items with sufficient frequency to retain it with any degree of accuracy?

11. "Second exits" or escapeways are generally intake airways. The best chance that men have when trapped in this way is to bulkhead themselves in dead-ends and wait for rescue. Frequently splitting the air in the ventilating current reduces this danger.

12. Every deep metal mine should be equipped with an efficient means of mechanical ventilation by which the air currents can be reversed quickly, if necessary; and every such mine in which several levels are being worked simultaneously should have its air circulation divided into a number of splits.

13. Some provision should be made to give danger signals or "all out" signals to underground men. Every metal mine should be equipped to introduce a stench into the compressed air lines in cases of emergency, and a supply of the stench-making material should be on hand at all times. Such arrangements are easily made and are not expensive, yet may be the means of saving many lives especially if all men are well drilled in their use.

14. Crews should be organized for effective between-shift inspections of timbered workings, shaft stations, airways, pump stations, etc.

15. Proper fire doors should be installed at strategic points to assist in the control of the ventilation.

16. The introduction of miners' electric cap lamps, and forbidding men to carry matches, flame-making devices, or smoking materials would be an important item in the reduction of underground fire hazards. Of course, if fuse is used for blasting, the men who split the fuse must be equipped with some type of flame-making device. These suggestions may be regarded as somewhat radical now, but they are feasible and the time will come when they will receive thoughtful consideration.

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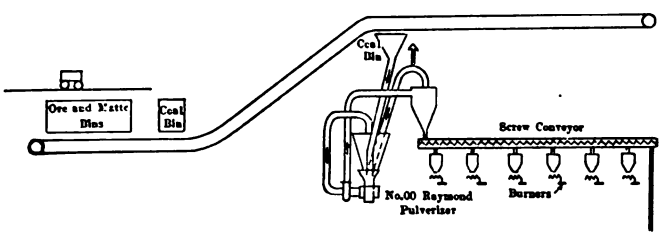
## Pulverized Coal for Use in Sintering

By E. H. Hamilton*

DURING the war the cost of crude oil for ignition of the charge in the Dwight-Lloyd sintering machine at the Midvale plant of the U. S. S. M. & R. Co. plant rose to such a figure that an attempt was made to substitute pulverized coal for the high-priced oil; the attempt was most successful.

The first experimental plant was described in the *Engineering and Mining Journal* (1919, **107**, 745). This plant, shown in the accompanying diagram, was used for determining the proper pressure and volume of air, the quantity of coal and the kind of muffle best adapted to the work.

Slack coal is delivered to one of the bins formerly used for ore. From this bin the coal is delivered by belt conveyors to a bin above a Raymond No. 00 pulverizer. The pulverizer grinds the coal, which is pneumatically delivered to a storage bin provided with a screw




Diagrammatic sketch, D & L. powdered coal layout.

conveyor, which carries the fuel to smaller storage bins, one of which is placed at the side of each sintering machine.

The fuel is fed, by a screw conveyor, into a stream of low-pressure air, which carries it into the combustion chamber under the muffle. The air is supplied by a fan formerly used for ventilating.

The Dwight-Lloyd machines delivering 95 to 100 tons of sintered product formerly required 75 to 80 gal. of oil per 24 hr.; 560 lb. of pulverized coal now does the same work. The latter fuel carries about 1 per cent water, 47 per cent fixed carbon, 8.3 per cent. ash, and develops 13,400 B.t.u.

No additional labor is required for handling the solid fuel, and the use of high-pressure air is now unnecessary. The present plant is giving highly satisfactory results.

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## Research Graduate Assistantships

ENGINEERING Experiment Station of the University of Illinois maintains 14 Research Graduate Assistantships and two more have been established under the patronage of the Illinois Gas Assn. To these assistantships is attached an annual stipend of $600. They are open to graduates of universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry. Applications must be in the Director's hands by March 1. For information, address the Director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

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## Methods of Underground Metal Mining

THE Institute Committee on Mining Methods is making an attempt to compile a comprehensive classification of mining methods and for that purpose has sent out a chart prepared by Prof. Frederick W. Sperr, of the Michigan College of Mines. This chart seemed to have such value that it is republished on the following two pages in order that it may be available to every mining engineer.

The committee desires the assistance of every member of the Institute in this work and solicits the examination of this chart and suggestions and criticisms to be sent to John E. Hodge, Chairman, 710 Security Building, Minneapolis.

If you are using some method that is not included in the scheme of classification published, the committee would be grateful for information relative to it.

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## Cost of Making Pig Iron in Pittsburgh

THE present freight rates on two tons of ore from the Lakes to Pittsburgh (two tons of ore being needed to make a ton of pig iron) are $2.80. The Interstate Commerce Commission has been asked to approve a rate reducing the freight to $2.01½. The pre-war rate charge was $1.92.

The present aggregate of freight rates for bringing to furnace the raw materials for one ton of iron compared with the data for 1912, is as follows:

| | 1921 | 1912 |
|---|---|---|
| Rate from mine to dock on two tons of ore .. | $ 2.06 | $1.10 |
| Boat rate and unloading | 2.48 | 1.20 |
| Lake to furnace | 2.80 | 1.92 |
| Freight on 1 1/10 tons coke | 1.80 | .80 |
| Freight on ½ ton limestone | .80 | .32 |
| Slag disposal | .54 | |
| Total | 10.48 | 5.34 |

If the reduction on ore rates that is now asked be granted, the total assembly costs will be reduced to $9.69½ per ton.

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## Tungsten in the United States

THE history of the tungsten industry in the United States, as outlined by the U. S. Bureau of Mines, is an interesting story.

In 1870, Sam P. Conger discovered the famous Caribou silver mine at Caribou, and a few months later

* Metallurgist, U. S. Smelting Co., Midvale, Utah.

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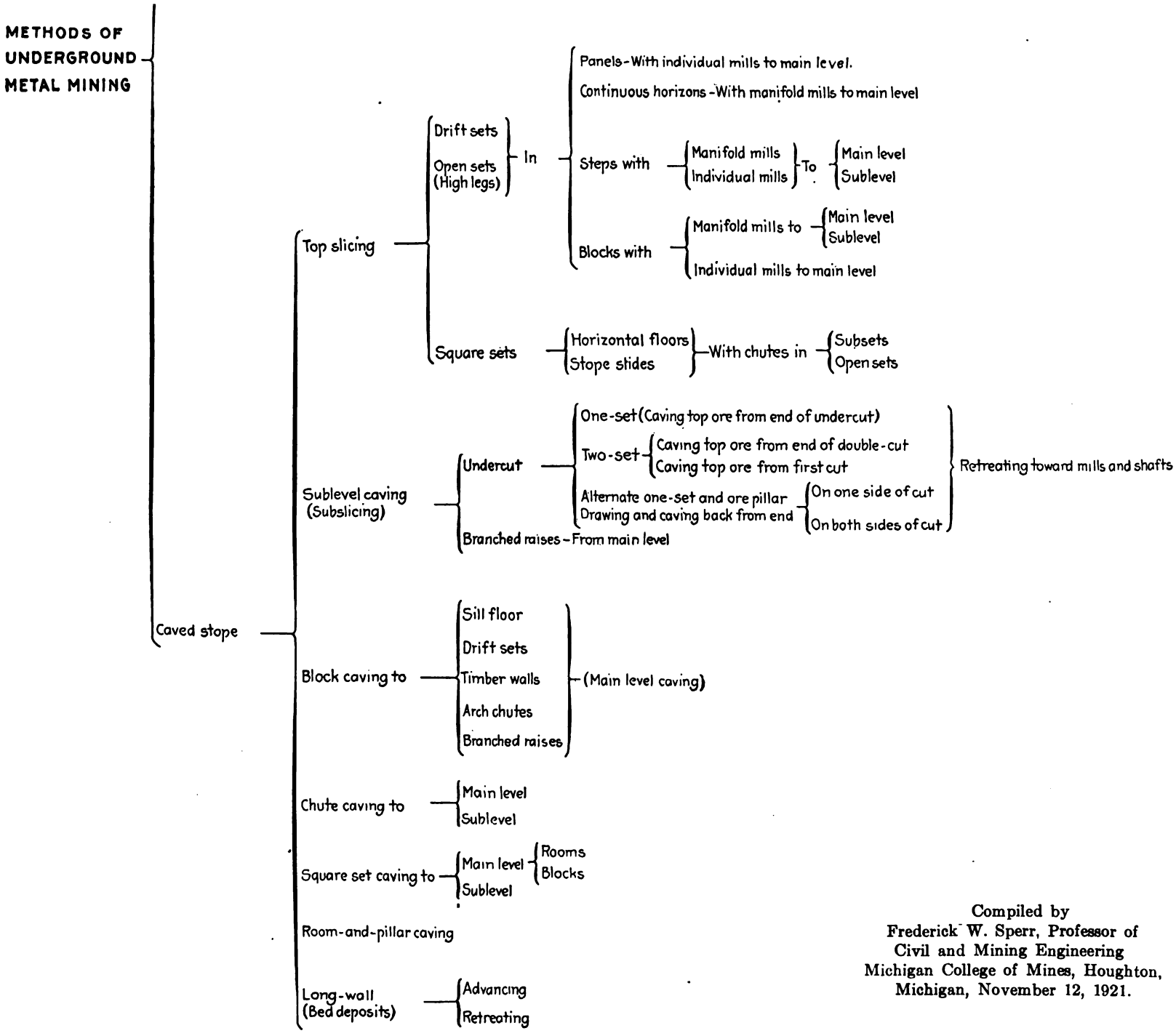


Compiled by
Frederick W. Sperr, Professor of
Civil and Mining Engineering
Michigan College of Mines, Houghton,
Michigan, November 12, 1921.

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the Boulder County mine, and Caribou was erroneously heralded as the richest silver district in Colorado and one of the largest in the world. The miners and prospectors who flocked into the district soon became familiar with a heavy dark mineral, found as "float," to which they gave various names, such as heavy iron, black iron, hematite, and barren silver. In the early part of the year 1900, Conger's partner, W. H. Wanamaker, who had seen the tungsten ores found in the Dragoon Mountains of Arizona, recognized this "float" as an ore of tungsten. Conger and Wanamaker kept their discovery a secret and in August, 1900, obtained a lease for the purpose of working the tungsten placers and developing veins. By the end of the year about 40 tons of high-grade ore had been taken out, but until the end of 1914 there was no important development

By the middle of 1915 the wartime demand for high-speed tool steel, of which tungsten is usually a component, became so great as to cause feverish activity among the owners of the known Boulder County deposits.

The price of tungsten rose to unheard-of heights, $75 a unit, or more, being the quotation for nearly two months, and at least one lot is known to have been sold for $105 a unit. These high prices caused the large users to import tungsten ores from South America, and later from China; the market broke rapidly, and during the latter part of 1916, 1917, and nearly all of 1918 was fairly steady at about $25 a unit. The small demand, and the large importations and stocks held by dealers, forced the price down so that early in 1919 all of the Boulder County producers were obliged to suspend operations. As a result, there has been a strong movement for placing a protective tariff on imported tungsten ores and products.

The development of milling practice in Boulder County, the ore-dressing methods in use and the local manufacture of ferro-tungsten and tungstic oxide are described in Bureau of Mines Bulletin 187, "Treatment of the Tungsten Ores of Boulder County, Colorado," by J. P. Bonardi and J. C. Williams, which may be obtained from the Director of the Bureau of Mines, Washington, D. C.

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## Coal Miners Claims vs. Facts

THE following excerpts from the *New York Herald*, of Jan. 22, 1922, tell their own story:

### A Telegram from John L. Lewis

To The New York Herald:

The position of the United Mine Workers is that they cannot live for any less than their present earnings and no wage reduction is possible after the expiration of the present agreements.

Shamokin, Pa., Jan. 21.

John L. Lewis,
*President United Mine Workers.*

### From a Speech by John L. Lewis to 2000 Anthracite Miners at Shamokin, Pa., Jan. 21, 1922

"The miners of the country are not willing to abide by a declaration made in advance of negotiations that there must be a reduction in wages in the coal industry. By what right does any one attempt to set up a power or influence to regulate our lives by merely saying wages must be cut $1 a day? We hold that this is a negotiable question about which the mine workers who are directly concerned should be consulted. It is an inherent right that the workers should have something to say as to the conditions under which they shall labor and the compensation they shall receive. We will do all in our power to avoid a conflict in an honorable way, but if that conflict does come the responsibility must rest with those creating the conditions that force such an alternative upon us."

### Special Dispatch to the Herald from its Washington Bureau

"Coal miners, threatening to plunge the country into a general strike April 1 unless a wage increase is negotiated to their liking, are earning more than workers in other principal industries. In some instances the wages are more than double those of other workers.

"The average earnings of bituminous miners range between $100 and $125 a month, according to a survey of a group of mines just made by the Department of Labor.

"The average earnings of workers in all industries range between $85 and $90 a month, according to the same survey. Labor Department officials do not rate their survey as completely descriptive for all the nation's 13,000,000 industrial workers. This is because it represents a cross section only of industry and is made up on the basis of payroll reports of some 300 concerns and corporations. But the corporations covered employ more than 1,500,000 workers, and fourteen widely varying industries are included.

"In the cotton finishing mills the average earnings are reported as slightly in excess of $60 a month. In the manufacture of cigars workers receive an average of $68 a month.

"The reports do show, however, that the coal miners' average earning power has been reduced faster in the last year than that of any other worker, with the exception of steel mill employees. The bituminous miner has suffered a loss of 27 per cent., the survey shows, while the steel worker is receiving 46 per cent. less than a year ago. Leather workers earn about 20 per cent. less and paper makers have experienced a like reduction.

"These reductions in the case of the coal miner are the result only of fewer working days. In the cases of other workers the reduction is due to reduced wage scales as well as to fewer working days. The rate of pay of the coal miners has not been changed in two years."

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# Routine Mine Sampling at Butte*

By DONALD C. GILBERT

Chief Mine Sampler, Anaconda Copper Mining Co., Butte, Mont.

PRIOR to July, 1919, the sampler at each mine of the Anaconda Copper Mining Co. in Butte did his work in his own way and was responsible to the mine foreman only. At that time, the sampling at all the company's Butte mines was placed in charge of a member of the geological department and standardized methods of doing the work were adopted. These standards were incorporated in a set of instructions accompanied by blueprints representing typical conditions. The main features of the instructions were as follows:

All samples to be cut at breast height and horizontally, regardless of dip of vein, and the horizontal width reported.

A single sample to include not more than a 5-ft. width of the breast and to weigh not less than 4 lb. for this width.

Where the vein is made up of two or more streaks of different hardness or mineral content, each streak is to be sampled separately and the average value of the combined width figured. If two streaks of ore are separated by a streak of waste, which is not sampled, in obtaining the average value of the breast the waste must be figured in with a zero assay.

Drifts to be sampled in the breast after each round.

Raises to be sampled for each floor raised. Each end to be sampled separately and the average width and value of the two ends to be used as the average of the floor.

All veins cross-cut to be sampled along the side of the cross-cut, at breast height and horizontally. Where the vein strikes at an acute angle to the line of the cross-cut, the width of sample must be corrected to show the horizontal width at right angles to the line of strike of the vein.

Rill stopes must be sampled across the full mining width.

In square-set stopes, each set must be sampled separately along the line of the caps. Waste portions of the vein which are mined for filling must not be included in the sample.

In the instructions, the method of taking separate samples of individual streaks in the vein was stressed. This practice tends to produce more accurate work than would be given by one sample across the entire width, for in the latter case it is easy to include too much or too little of the higher grade portion of the vein in making the cut. Where the individual streaks are sampled and the average value of the vein is calculated on the basis of the width and value of each streak, the result is accurate for all practical purposes, but is not exactly correct if there is a difference in the specific gravity of the streaks. At times this difference may become pronounced enough notably to affect the results, but the occurrence is so rare that it is ignored. Thus it sometimes happens that a vein consists of two parallel streaks of very different type; one may be composed almost entirely of iron pyrite with high copper content, while the other may contain the usual quartzy gangue with a much lower copper content.

As a simple illustration, let us assume the specific gravity of the pyritic ore as 5 and that of the siliceous ore as 2.5. In Fig. 1 we have a vertical vein 6 ft. in width, which is also the width of the drift, composed of two grades of ore. On the left, a 2-ft. streak assays 12 per cent. Cu. and has a specific gravity of 5, and the remaining 4 ft. of the vein assays 2 per cent. Cu. and has a specific gravity of 2.5. By the usual method of figuring the average assay of the breast, we have:

$$\frac{(2 \times 12) + (4 \times 2)}{2 + 4} = 5.3,$$ or 6 ft. of 5.3 per cent. Cu.

This supposes that the total weight of 12 per cent. ore which would be broken if a round were blasted would be one-half that of the 2 per cent. ore, as the weight of each is assumed to be proportional to its width, which is incorrect. The total weight of each class of ore broken would be the same, since the 12 per cent. ore, while only half as wide as the 2 per cent. ore, has twice its specific gravity. The true assay of the ore broken in the drift will be:

$$\frac{12 + 2}{2} = 7$$ per cent., and the average assay is 6 ft. of 7 per cent. Cu.

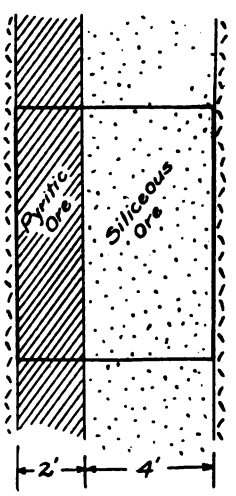


FIG. 1.—VERTICAL VEIN.

Sample cuts are horizontal as it is easier to make the cut in this direction and the figure is convenient for other work. The veins are quite steep as a rule and the tonnage in a given block of ground is figured on the basis of the horizontal width of the ore. In Fig. 2, which represents the cross-section of a vein between two levels, the usual method of arriving at the cross-sectional area of the vein would be to multiply the true width *A* by the dip length *B*. The same area is found by multiplying the horizontal width *C* by the lift *D*, both of which figures are obtained without calculation.

After standard sampling methods were adopted, the next step was to find the degree of accuracy that was being obtained by the samplers. The chief sources of error in sampling are lack of knowledge of the work at

*Abstract of paper that was awarded the President's Prize, at the meeting of the Directors of the A. I. M. E. on Oct. 21, 1921.

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hand, and carelessness. Careful training will eliminate the former but the latter must be constantly combatted. At times, the sampler must temporarily hold up the work of miners who have little drilling time left and they do not enjoy the delay; so he gets his samples in a hurry. And when a raise through a 200-ft. lift gets up a score of floors from the sill, and the air is warm and the rock is hard, he often finds it convenient to get his samples in the shortest possible time. In addition, each sampler has his own personal factor, whereby he tends to include too much or too little of the richer portions of the ore, even when working with the

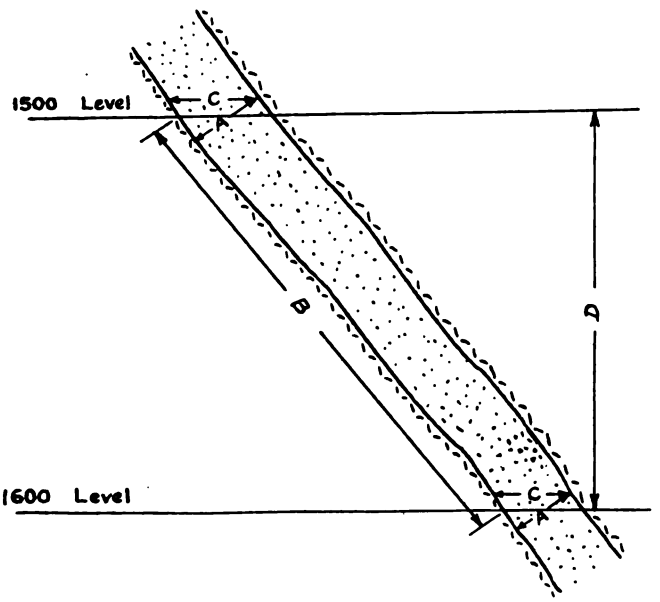


FIG. 2.—CROSS-SECTION OF VEIN BETWEEN TWO LEVELS

greatest care. This error is cumulative, but if it is determined the sampler can be coached to eliminate it. For this reason, rating tests were made with each mine sampler and an approximate determination of his personal factor was made.

## RATING TESTS

Each man was rated on the results obtained in a series of check samples taken under varying conditions. On entering a place to be sampled, the exact width of sample to be cut was first decided, and the mine sampler and chief sampler each cut an independent sample between these limits. If any error on the part of the mine sampler was observed the fault was explained to him at the time, but the sample was retained in the series. Any probable source of error from unconscious salting was also explained where the conditions were met. It was not expected that the number of samples taken would be great enough to serve as a safe basis for the determination of the sampler's personal factor to a close degree, but it was believed that where the mine sampler's results were in the majority of cases higher than those of the chief sampler, or were generally lower, as the case might be, his approximate percentage of error could be determined. Also, the comparison of one unknown factor, the mine sampler, with another unknown factor, the chief sampler, could decide nothing unless means were found to check the accuracy of the latter.

It was decided at the start that the average results that would be obtained by the total number of samplers in question, if each were to cut an independent sample across the same breast of ore, would be very nearly correct but would probably lean toward slightly high results. This assumption was made because of two observed tendencies among the samplers. The first is the tendency of some men to take too much of the high-grade portions of the vein and fail to include a representative amount of the lower grade material. Since good ore is the commodity sought for in mining operations, it is a normal tendency for a man to focus his attention on it. The second observed tendency is for some samplers to keep too far on the safe side. Dilution of ore with waste, in mining, frequently runs the grade down to such an extent that the foreman insists that the sampler is doing poor work and showing greater values than are actually present, so that the sampler finally adopts the plan of including an excessive amount of poor material in his sample. As a result of an estimated balance of the opposing factors, it was decided that the average sampler was probably getting too high results.

In the determination of the personal sampling factor of each man, the results of the chief sampler were assumed to be 100 per cent. correct, and the sampler's factor was represented by an index number corresponding to the ratio of his average results to those of the chief sampler. At the completion of the work, it was found that the average index number of the eighteen men in question was 107, compared to the assumed 100 of the chief sampler, which was accepted as a check on the accuracy of the latter, since, as stated above, it had been previously expected that the average results would be slightly high.

In this work an attempt was made to sample as many different types of vein as possible. While the rule was to sample each individual streak, the streaks themselves were often of such description as to make close sampling difficult. Thus in some instances a streak of good ore, three or four feet in width, would contain several minor streaks of alternating high- and low-grade material. In these the high-grade ore was in some instances harder, and in others was softer, than the low-grade material, in other cases the valuable minerals occurred in a very spotty manner. Places of this description were considered ideal for the purpose at hand as they made it possible for the sampler to demonstrate his ability to make a uniform sample cut regardless of the grade of material at varying points along the cut. Careful record of the character of the vein sampled, its hardness, distribution of values, and other data was made for each sample.

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Tables were compiled, in which each sampler was given an index number. In one case, this index number was very high, 147. The ratios of this sampler's results to those of the chief sampler varied in individual cases from $^{125}/_{100}$ to $^{180}/_{100}$, the average being $^{147}/_{100}$. There was no doubt that this man was getting much too high results, and close observation showed that he invariably took too large a proportion of the high-grade ore, which, in most cases, was softer than the leaner portions of the vein. Other samplers were also found to be getting too high results, on the average, and in each case a careful observation of the man's operations and an explanation of the probable causes of his error was made; a second series of samples showed decided improvement. When the sampler's index number was between 90 and 110, his work was considered satisfactory, unless the variation of his individual samples had been too great.

### Records and Reports

From the rating tests, it was decided that certain samplers had a tendency consistently to get too high or too low results, and that this personal factor had been approximately determined. It was found, also, that certain samplers were so erratic in their work that no normal tendency was apparent in the results they obtained. The peculiarities and failings of each man, therefore, were studied and corrected as much as possible, and occasional series of check samples were run to make certain that the quality of the work was being improved.

Each day the sampler receives an assay return, in duplicate, on the samples sent from the mine on the preceding day; one copy of this, with the necessary data concerning the position of the samples, is put on file in the shift-bosses office, and the assays are then entered on the sampler's own records. A daily report is made out and sent to the geological department, showing the location of each sample and giving the average value of the ore exposed in each working place. At the geological department, the chief sampler records the assays in a loose-leaf book in which one sheet is kept for each working place. The report is given to the geologist for that particular mine, which enables him to keep in touch with each day's development.

One day of each week is " contract-measuring day," and at this time all advances for the week are given to the sampler by the engineers. The sampler makes a weekly advance report which shows the advance, total length and average assay and width of ore exposed in each drift and raise, and the average width and value of all veins cross-cut. If new development working places have been started during the week, their location is given on this weekly report. Copies are sent to the mine superintendent, mine foreman and the engineering and geological departments. At the end of each month a summary of the preceding four or five week's work is made out in similar manner. Standard forms are used for all reports.

In the geological department, a file of weekly and monthly advance reports is kept, but as the task of finding the records of any working place in this file would be long and tedious, a graphical record or "assay-curve system" has been adopted. In this system, the assay record of each drift and raise is plotted on a card of heavy cross-section paper, and the cards for each mine are filed in the numerical order of the working places; cross-cuts are not included in the system. These cards are posted from the weekly advance sheets. For the drifts, the horizontal scale is 1 in. = 50 ft. of drift-length, which is the same scale as the geologic maps of each mine level. The assay curve is plotted to the vertical scale of 1 in. = 10 per cent Cu. (Zn, Pb or Mn) and 10 oz. Ag, and colored inks are used to differentiate between the various metals. The width is shown by figures and represents the average width of ore exposed during the week's advance, as the curve represents its average value. Raises are plotted in similar manner but at right angles on the cards to the direction of the drifts. The assay curve for each drift and raise is kept on a separate card and placing the card under the fifty-scale geologic tracing shows the data in the most convenient position for use.

### Results

Sampling, at its best, is far from being an exact science. Two trained samplers, equally proficient and working with care, will often obtain from the same breast samples that will differ by 25 per cent. or more. For this reason single assays must always be discounted; they cannot be accepted as correct to a closer degree than has been found to apply under the circumstances. Where a competent man has taken a number of samples along a drift or raise, the average of the lot may be accepted as very close to the true value of the ore exposed, since his errors are compensating, not cumulative. A check on this fact has been made at various times by means of duplicate samples taken through 100 ft. or more of drifting, the average value of the ore drifted through being obtained separately for each set of samples. The greatest variation found was 4.2 per cent. Cu. and 3.0 oz. Ag, compared to 4.4 per cent. Cu. and 3.1 oz. Ag. in 93 ft. of drifting.

It is not claimed that investigation and standardization of sampling methods in use in the Butte mines of the Anaconda company has resulted in obtaining representative samples of extreme accuracy, but it has resulted in definite knowledge of the degree of accuracy that was actually being obtained and in bringing this within the allowable limits of variation. Finally, the maintenance of this standard requires constant supervision and frequent duplication of each sampler's work.

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# Undesirable Diversity in Non-Metallic Mineral Products*

By OLIVER BOWLES

Quarry Technologist, Bureau of Mines, Washington, D. C.

SUPERFLUOUS varieties and standards which are meriting the critical scrutiny of the manufacturing industry have a special significance in the non-metallic mining industries, where many of the final or intermediate products are manufactured at the mine or quarry. Such processes of manufacture must be considered an integral part of mining in its broader sense. Improvements may be either elimination or standardization. The chief requirement of elimination is an agreement between consumers and producers based on facts deduced from statistical data.

Standardization is much more complex. Standards may be established only when a very thorough knowledge has been gained of the physical and chemical properties of the products, and the requirements of consumers. The activities of the Bureau of Standards are largely directed toward such determinations.

Paving-brick manufacturers, together with highway engineers, representatives of certain engineering societies, and Government bureaus, have agreed that of the 66 styles of paving brick on the market 11 only are essential and 55 are superfluous. Steps have been taken to reduce the output of all but the 11 standard types.

It is customary for manufacturers of structural slate to prepare it in sizes specified by builders and architects. Thus the material cannot be manufactured in advance and the result is irregular activity of mills, delays in filling orders, etc. To improve this condition, the Structural Slate Co. has issued a series of pamphlets giving complete specifications of structural slate for various purposes. Architects find it so much easier to order slate from these sheets that standard sizes are specified in preparing plans for new structures.

Slate switchboards are usually manufactured after the order has been received. One manufacturer claims that 80 per cent. of all switchboards are of standard sizes, and he keeps such sizes in stock. The facility with which orders may be filled from stock, and the improved quality of seasoned switchboards, will undoubtedly influence electrical companies toward a more uniform standardization in size. Simplicity could be further attained by the elimination of minor irregularities in style; for example, in the beveled edges.

Similar tendencies exist in the structural block sand, gravel and crushed-stone industries. Limestone quarrymen have found it advantageous to establish a standard size 8 by 4 by 4 ft. for mill blocks, and large piles of such blocks are stored for seasoning before shipment to stone-cutters. Concrete blocks, artificial stone, terra cotta, and similar types of molded building blocks are gradually being standardized.

Producers of sand, gravel and crushed stone have been greatly handicapped by the varied requirements of consumers. For the past two years various organizations have been striving to establish standard screens, and to eliminate all unnecessary sizes. A notable step in this direction is the preparation of a set of tentative specifications, issued in 1920, by the American Society for Testing Materials working in coöperation with the Bureau of Public Roads.

Feldspar is not standardized as to either grain sizes or purity. No. 1 spar is variously defined as dental spar only, as pure feldspar of any kind, or as a mixture of feldspar with a small percentage of quartz. Some limit No. 2 spar to 5 per cent. quartz, while other consumers classify as No. 2 a spar that contains as much as 25 per cent. quartz. Specifications may call for fixed percentages of soda and potash, or such requirements may be omitted.

The standardization of mineral fillers is practically untouched. Such standardization, accomplished through a comprehensive study of the subject, would not only promote better manufacturing processes, but would be of material benefit to producers.

The classification of mica is very confusing, for standards differ not only in different countries but in different parts of our own country. The most widely known domestic standard includes punch, circle, and rectangles of various sizes. Canadian phlogopite is graded in sizes of rectangles that differ from most of the United States standard sizes. India mica is widely used in the United States, and it is classified not on the basis of the sizes of rectangles obtainable, but on the basis of the area of good mica in the sheet, for which 10 arbitrary grades have been established.

In quality, domestic mica is classed as clear, slightly spotted or stained, and heavily spotted or stained. No definite boundaries have been fixed for these grades. Mica sold as "clear" is often spotted, and this has prejudiced users against domestic mica.

* Abstract of paper to be presented at February Meeting of the Institute. This paper will not be printed in full. Published by permission of the Director of the Bureau of Mines.

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# Correspondence and Discussion

## Licensing an Example of Unnecessary Laws

I REGRET that I could not be present at the meeting of the New York Section but desire to state that I am unalterably opposed to any licensing law for mining engineers.

I do not believe that it will be a protection or benefit to the public or to the profession. Such legislation is merely an example of the unnecessary laws with which American life is now being hedged in. It will mean an expense to the engineer without any return and a further expense to the general tax payer who will be required to pay for any deficit not covered by the fees collected. The only advantage accruing from such legislation will be to the professional politician who will thus obtain further plums to be distributed among his constituents.

S. H. BALL.

New York, Jan. 11, 1922.

## Licensing Engineers Not Analogous to Licensing Doctors

THE chief arguments that I have heard in favor of licensing engineers are that it is necessary in order to put us on the same plane with lawyers and physicians and that it is desirable in order to prevent overcrowding of the profession.

As regards the first point, I do not feel that the profession of engineer is at all akin to that of the doctor or lawyer. From the very nature of their practice the two latter are much more in one place than is the engineer and a state license is practically all that they require. If one could be at all sure that one state license was all that one required, it would be a small matter, but where one might be forced to take out 48 state licenses at the beginning of each year, for fear that he might be called upon to practice in those states during the year, the matter would become exceedingly burdensome. I recall one of our members, when this matter was under discussion nearly a year ago, going over his books and finding that he had actually worked in 28 states in the calendar year 1920. I remember that I myself was actually at work in 11 states during that year. Probably neither of these is at all unusual among our members.

As regards the second reason given, to avoid overcrowding the profession, most of us have never been willing to stand for labor-union principles and this seems to be the adoption of their foremost tenet. I myself feel that this is an utterly indefensible excuse; that if we are afraid of competition from overcrowding we had better get out of a profession where new ideas and new men should be welcome.

In conclusion, I am in favor of getting out and fighting engineer licensing bills, both as regards the passing of new ones and looking toward the repeal of the present one in New York State, and I shall be glad to contribute to any campaign to do this.

D. M. LIDDELL.

New York, Jan. 11, 1922.

## Licensing Engineers and Architects

YOUR treatment of the above-mentioned subject in the January issue of the magazine., MINING AND METALLURGY, has my active and earnest support. My work during the year takes me into more than half of the states of the Union, as well as Canada, and I am opposed to impositions placed upon mining engineers by "mistaken and self-styled" engineers who are fostering this legislation.

It now seems that a certain growing political organization which has for its purpose the cleaning up of politics, interesting business men in politics, as well as standing for nothing short of red-blooded Americans in office, may be able to do something to have mining engineers excluded from provisions of the law, especially in the state of Minnesota. The engineering societies of the state all support the registration, and anyone who disagrees is branded a "Bolshevik."

If all mining engineers could be organized for concentrated attack, aided by representative voters of the realm, that part of the law relating to mining engineers may be repealed, as an initial step.

Appeals to register in this state have been made more than once, which signifies lack of support, similar to that of New York, where "250 applied out of 30,000."

A MINING ENGINEER IN POLITICS.

Duluth, Minn., Jan. 13, 1922.

## Licensing Not Inevitable

IN CONNECTION with the meeting of the New York Section of the American Institute of Mining and Metallurgical Engineers, Inc., held last night to discuss the licensing of engineers, I desire to place myself on record in opposition thereto. As a member of the American Society of Civil Engineers, I appeared some time ago before the committee appointed to investigate this matter, and gave as my opinion that

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the only people who would benefit by the licensing of engineers would be those administrating the fees collected from engineers, as I did not consider licensing would be of value to the engineer, to the state or to the public.

While at the start the Licensing Board may be composed of representative engineers, I doubt if this would continue for any length of time, and eventually the Board would be considered a place to reward political services.

My own opinion is that the principal engineering societies, instead of compromising with those who advocate licensing, should fight it to the bitter end, for I believe, with a united front, the laws already passed can be repealed, and the passing of similar laws in other states can be prevented. The more I study the question, the less I am inclined to agree with some of the civil engineers who consider that licensing is inevitable, and therefore engineers should join and see that a proper law is formed instead of trying to oppose it.

It is possible, of course, that my opinion may be erroneous and may be based on insufficient data. For this reason I suggested to the above committee, and now suggest to you, that a letter should be written to every member of the principal engineering societies living in, or doing business in, a state where there is a licensing law, asking him two questions:

1. Whether, by experience, licensing has justified itself;

2. If not, whether it should be amended or repealed.

I am a great believer in the superiority of fact over opinion, and should the majority of responses indicate that licensing in practice has worked out successfully, no one would be more ready than myself to change my opinion.

PHILIP W. HENRY.

New York, Jan. 12, 1922.

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## Licensing Engineers Will Not Protect the Public

I AM sorry that I cannot attend the meeting of the New York Section this evening. The subject that it is going to discuss is of great interest and importance. I think that the movement toward the licensing of engineers ought to be checked; and there should be, furthermore, concerted effort for the repeal of such legislation in the states that have enacted it.

The fundamental objection, I think, pertains to the manifest difficulty of defining the engineer. Engineering was formerly divided into two heads, *viz.* military and civil. With the development of our civilization, the engineers in civil life began to subdivide themselves naturally into mechanical engineers, mining engineers, electrical engineers and so forth. Later on these great groups became the subject of further subdivision, with the result that at the present time an engineer may be experienced in a certain kind of engineering work without knowing much about other kinds even under his own generic heading.

The licensing of men as engineers by the state would manifestly be no protection for the public, for while a man so licensed might be a competent land surveyor he might be incapable of building any kind of a bridge, and still less of equipping a mine. Yet, a state license as an engineer would sanction his practice in any work for which he could find anybody to employ him. Instead of this being any protection for the public it would probably result in the ignorant being more easily duped. The consequences of such legislation may therefore be expected to be mischievous rather than salutary.

On the other hand, engineers who are really such, practicing honestly in their specialties and recognizing their own limitations, would find themselves greatly hampered, especially when their work extended beyond the limits of their domiciliary state. They would be subject to considerable license fees, perhaps in numerous states, they would be the victims of discordant laws, often expressed in uncertain ways without as yet any interpretations by the courts, and they would become the subjects of great irritation generally.

I do not think that the argument that engineers should be licensed like other professional men is meritorious. The analogy is not close. The medical man, for example, comes directly in contact with the public and the latter needs protection against quacks. It is said that there are 200,000 engineers in the United States. The great majority of these are men who are employed by senior engineers, by large firms or by corporations, who know far better the capacity of the men whom they employ than any licensing board can possibly know. The relatively few who come in contact with the public do so in superior ways, and about the last thing in the world that their clients would ask of them would be the question whether they have been duly licensed.

The farmer who wants to have his land surveyed, who wants to have the work done properly, and who perhaps is not well acquainted among engineers who do such work may be benefited, by having it done by some one with a state certificate. I do not know how that might work out, but it is the only contact between engineers and the general public that I think of; that is to say, the only contact unless plumbers and mechanics of their ilk are to be considered as sanitary engineers, heating engineers, etc. If so, I should say let them be licensed, but let it be as "sanitary engineers capable of doing plumbing work," or under some such specification.

However, the idea of undertaking to license engineers broadly seems to me to be rather ridiculous. I do not think that it is necessary to elaborate further upon the points that I have made in this communication, for the mere statement of them will indicate to the members of the New York Section whither they lead.

W. R. INALLS.

NEW YORK, Jan. 11, 1922.

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# Abstracts of Institute Papers

All of the following papers will be presented at the New York Meeting, Feb. 20–23, 1922, and will be printed in full in the Transactions.
A copy of any of these papers in full will be sent free to members on application, for which a request blank is furnished on page 32 of Advertising Section.
Discussion of papers invited.

## Underground Fire Prevention by the Anaconda Copper Mining Co.

By E. M. Norris, Butte, Mont.

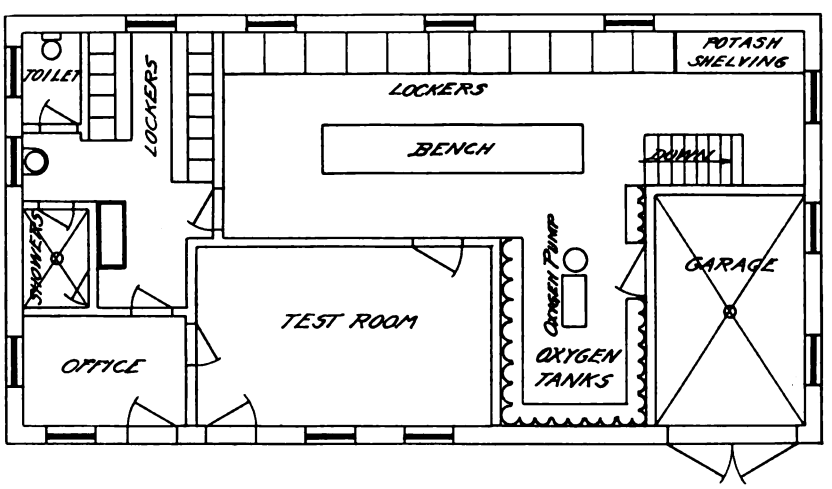
DURING the winter and spring of 1917, an unprecedented number of underground fires occurred in the Butte district. With one exception, these fires were caused by the failure of electrical equipment.

Five local conditions that contributed toward a heavy fire risk were: (1) The heavy continuous timbering necessary for mine supports; (2) the strong ventilating pressures in the shafts and main airways; (3) the subsidence and faulting movements in the country rock, which ruptured cables and displaced trolley and lighting wires; (4) the strongly acid mine waters, which quickly developed any weak points in the electrical insulation; (5) oxidation in old stopes containing large amounts of timber.

In the summer of 1917, a comprehensive plan of fire prevention was begun by the Anaconda Copper Mining Co., comprising fireproofing, remodeling and strengthening electrical insulations, extension of underground water system, control of ventilation, maintaining efficiency of fire-fighting crews, and reorganization of fire patrol.

In considering fireproofing, some method of applying a durable coat of fireproof material to the mine timbers was needed. The first experiments were made with a plaster composed of one part cement, one-half part fireclay, and three parts sand, applied by hand over herringbone metal lath. This was too soft and friable for traveling ways, where it was subject to abrasion. The cement gun was tried out with a three to one mixture of sand and cement. A ½-in. coating of gunite applied over poultry netting or metal-lath reenforcement proved to be durable and fire resisting.

Preparations were made to fireproof the tramway of No. 1 hoisting shaft. This was a four-compartment shaft, 2475 ft. in depth; it was lined with framed shaft sets of 12-in. fir timber; the sets were 7 ft. by 18 ft. 10 in. over all, and were spaced 5 ft. on centers. The sets were lagged with 2-in. pine plank, placed against the rock walls. The timbers and lagging were covered with a ½-in. coating of cement, applied with the cement gun over 27-gage diamond-mesh metal lath. The fireproofing operation was completed in the fall of 1917. Because of the success of this operation, it was decided that the twenty-four main hoisting shafts operated by the Anaconda company in the Butte district, not already so, should be made downcast shafts and similarly fireproofed; also that the same treatment should be given all surface tunnels carrying steam, air, and electric power from plant to mines.




PLAN OF TRAMWAY RESCUE AND TRAINING STATION; STOKEROOM FOR SUPPLIES IS IN BASEMENT AND CLASSROOM IS ON SECOND FLOOR.

Twelve type N-I cement guns were procured and the work pushed as fast as operating conditions would allow. One or more shafts at a time were withdrawn from ore production, retimbered where necessary, and fireproofed under the direction of the mine foreman. Each foreman selected a crew, from among his shift bosses and shaftmen, who were trained at one of the mines where fireproofing work was in progress. The work was carried on continuously by three 8-hr. shifts. The crew for each shift consisted of one shift boss, six shaftmen, who nailed on the metal-lath reenforcement, two nozzlemen for the cement gun, two runners for the cement gun, station tenders, topmen, etc.

Regarding the details of the gunite work, some general conclusions may be summarized. Poultry netting makes satisfactory reenforcement for covering wooden surface structures of continuous plane sur-

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faces, such as buildings and ore bins; expanded-metal lathing is to be preferred where much fitting is necessary, as on underground timbering. A gunite covering ½ to ¾ in. thick on wooden surfaces is sufficient for fireproofing purposes. The sand should be clean and should be screened through a screen four or five meshes to the inch. If the sand is very dry, it does not mix well with the cement; 6 to 10 per cent. moisture is best. Moisture in excess of 15 per cent. is liable to block the material hose. A mixture of three parts of sand to one of cement is best.

The Tramway shaft has had 3½ yr. continuous service in ore production since the fireproofing work was completed. A recent inspection of the shaft showed that the timbers from the surface to the 1600-ft. level were 92.5 per cent. covered with gunite; from the 1600-ft. to the 2800-ft. level, the timbers were 85 per cent. covered with gunite. The depreciation of the gunite is due to falling rocks from overloaded skips.

## Bureau of Safety of Anaconda Copper Mining Co.

By C. W. Goodale and John L. Boardman, Butte, Mont.

THE motives behind the organization of the Bureau of Safety were twofold. First, there was the policy of the company toward its employees, which was one of fairness and consideration for their welfare and which entails the prevention of injuries; second, in order to prevent injuries, a study of their causes was essential, and this study could be made only by a thorough systematic classification of accidents, which required a special department to form and carry out the plans.

The Bureau of Safety was organized to begin operation Jan. 1, 1914, but practically all of the first year was and spent in collecting data, making plans, etc. This department is semi-independent of others and reports directly to the president and general manager. It consists of the president of the company and the managers of the following departments: mines, Washoe Reduction Works, Great Falls Reduction Works, coal department, lumber department, B. A. & P. railway, and the chairman of the Bureau of Safety.

Working under this group is the General Safety Committee consisting of the manager of mines, as chairman, the general superintendent, two assistant general superintendents, and the heads of the following departments: mechanical, geological, sampling works, framing plant, and purchasing, as well as the safety engineer.

Operating under the General Safety Committee are the group safety committees, consisting of the Anaconda group of mines, Boston & Montana group of mines, zinc group of mines, Washoe reduction works at Anaconda, B. & M. reduction works at Great Falls, coal department, lumber department, and the B. A. & P. railway. Each of these group safety committees was in charge of the superintendent or manager of the group represented and the committee consisted of the foreman of the mines or works that the committee served, as well as the safety engineer.

These foremen and superintendents had met regularly for the purpose of discussing costs, efficiency, and methods, therefore it was only necessary to add, at these regular meetings, the discussion of safety matters.

On the completion of the work of organization of the new bureau, an inquiry as to the causes of accidents was made. It was decided to adopt the shifts as a basis upon which to compute accident rates, and ten thousand shifts was made the unit, partly because it is an easy figure to work with in the decimal system and partly because it is probably near the maximum number of shifts that a man might work underground in a life time. An accident rate thus based shows the chances a man has of being injured in a lifetime of work.

In 1913, the company decided to award cash prizes for accident prevention, to the foremen having the lowest accident rate per 100,000 shifts, but this offer was discontinued, for various reasons, after two years of operation.

At first the Bureau of Safety paid little attention to safety rules; the general manager compiled a four-page pamphlet of fundamental rules and a copy was given to each employee. The idea was to keep down, as much as possible, the number of rules but to enforce those made. As the work developed and accident records began to reveal dangerous practices, placards, either pictures or printed matter, calling attention to the danger were posted about the mines and works. Many of these placards have become rules in effect. Later these rules were assembled and are now ready for publication in book form; they are given in full in the paper.

It was early realized that, while exact enforcement of safety rules and holding foremen responsible for accidents would do much toward the prevention of accidents, the greatest factor was the interest taken by the workmen themselves. In order to get the case before all employees in the proper light the publication of *The Anode* was begun in January, 1915. Supplementing *The Anode*, a complete set of motion pictures, showing the numerous operations from the mining of the ore, in Butte mines, to the making of wire bar, at the Great Falls smelter, with safe practice and safety slogans interspersed and emphasized by red film, were made and have been shown free at various times to employees. There are twelve reels; about 9000 ft. of film.

It is fortunate that the originators of the Bureau of Safety did not proceed on the basis of cost alone, for it is feared, though not definitely known, that unless the value of safety work, from the standpoint of morale, is considered, the balance would not show favorably. However, it can be definitely stated that considering costs and balancing against them all the various values

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and advantages of the safety campaign, the department has paid immeasurably, and we recommend to anyone desiring to go into the safety work that the key to success is sincerity on the part of those so engaged; not from a purely financial standpoint but rather from a desire to alleviate the suffering and minimize the loss to workmen due to industrial accidents.

## Efficient Ventilation of Metal Mines

By D. Harrington, Denver, Colo.

EFFICIENT ventilation of metal mines consists in having such complete control of air currents that there is always supplied at places where men work sufficient moving air to allow working at maximum capacity without injury to health; and, in case of underground fire or of surface fire in the vicinity of mine openings, control of underground air currents which may be quickly reversed or sent into or excluded from any region and fire fumes confined to part only of the mine workings.

After several years study of miners' consumption, the writer is convinced that long continued breathing of air impregnated with large quantities of any kind of finely divided dust, such as is found in a large number of the working places of our mines, will ultimately produce some respiratory disease, whether it be asthma, bronchitis, or phthisis; and the progress of these diseases is hastened if there are also present high temperatures, high humidities, or harmful gases or if there is present (and allowed to remain to be breathed) large quantities of the finely divided dust when air temperatures are low, hence favorable to maximum performance of work with accompanied maximum breathing into the respiratory passages of the harmful material. It is generally accepted that coal miners under the age of fifty are much more free of these respiratory diseases than are metal miners, and it is practically certain that this immunity of the coal miner is due largely to the fact that working places in coal mines are much better ventilated than those of metal mines. A close study of dust conditions in metal mines convinces the writer that, except for preventing formation of dust, the most efficient preventive of undue dustiness of air breathed by metal mine workers is the coursing of adequate currents of air past the places where dust is produced or is being thrown into the air—thus replacing the dusty air with dust-free air.

Failure to remove poisonous fumes from detonation of explosives at confined working places, reduces vitality of workers; not infrequently these fumes cause death. Failure to remove smoke from working faces prevents the worker from properly inspecting overhead conditions and thus preventing many accidents. With $CO_2$, nitrogen, or, as occasionally occurs, the explosive methane, inadequate ventilation and knowledge of gases usually results in hospital cases or fatalities, or possibly in occasional closing of the place or the entire property until outside aid or information may be secured.

After about five years spent largely in a study of metal-mine ventilation, supplementing over fifteen years spent in more or less intimate contact with ventilation in coal and, to a less extent, in metal mines, the writer believes that no mine (coal or metal) can be efficiently ventilated without the use of mechanical equipment (especially fans). While there are probably well-ventilated mines with natural currents (that is, without the intervention of fans or other mechanical equipment), he has never visited a property of that description.

Each mine should have at least one fan, of comparatively large capacity, to control main underground air currents. Preferably, this fan should be located at the surface, in fireproof housing, and should be so arranged that the direction of currents may be reversed in a very few minutes by manipulating a few doors. The most up-to-date practice is the installation of electrically driven, high-speed fans; and where gases, such as $CO_2$ or nitrogen, come into workings from strata, it may be desirable to keep underground air under pressure. Local conditions will determine whether the fan should be operated as a suction or as a force unit, but, in general, the main fans exhaust foul air from mine workings. As a rule, it is desirable that the main operating shaft or tunnel be an intake and that the fan should not be located at the main operating shaft or tunnel. Where possible to arrange, the main operating (haulage) shaft or tunnel should not be used as a main air course, but this recommendation can seldom be carried out. Large mines should have approximately 15,000 cu. ft. per min. for each 100 men employed, if the underground rock and water are cool, and at least that amount per 50 men if the workings are over 80° F.

Metal-mine officials rarely recognize the necessity of sealing abandoned workings in order to force air currents to live workings. The practice of allowing intersecting openings,—horizontal, inclined or vertical,—to remain open to air circulation, or leakage, dissipates air into places where it becomes impregnated with fungus spores, $CO_2$ from timber decay, increased temperature and humidity and possibly dust. Frequently, it is not needed in the places where it goes (though needed badly elsewhere) and after having become vitiated passes into places where men work. Closing places that are not being worked would frequently result in the recovery of much material that is now lost and would remove a common source of danger to life and limb in metal mines in addition to greatly aiding ventilation.

A pipe introduced on the Rand for ventilating headings has some advantages over galvanized-iron and canvas pipe, according to S. de Smidt. This pipe is

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made of concrete, reenforced with wire netting, in 6-ft. or 8-ft. lengths, and is 1 in. thick for 12-in. pipe. Sleeves about 4 in. wide are used, to cover the joint between the pipe; soft clay is pressed into the joint and from time to time inspected and tightened. The sleeves have the advantage of permitting gradual bends, and if necessary, special curved shapes may be made. The pipe is laid on the floor, which is another advantage, as it can be covered with loose material and thus protected from falls of rock. The greatest advantage, however, is that, the concrete being a non-conductor, there is less heating of the air in traveling long distances to a hot level. The recently perfected ventilation installation at the Colorado mine at Butte, Mont., cost over $70,000, but shortly after its installation it was found that the saving in electrical power for compressing air was about $18,000 per year. In addition to several indirect benefits realized, the average efficiency of all underground employees was increased at least 50 per cent. In a private conversation with the writer, Mr. Bruce stated that with the mine working to its normal capacity (two full shifts), the various savings effected through the ventilation installation would readily return its entire cost of over $70,000 at least once, and probably twice, annually.

This paper has been able to touch on only a comparatively few points in connection with ventilation of metal mines, considering safety and health only to a slight extent, with intent to concentrate on suggestion of desirable methods to obtain efficient metal-mine ventilation, with a slight amount of attention to costs and results translated into dollars and cents.

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## Ventilation of Butte Mines of Anaconda Copper Mining Co.

By A. S. Richardson, Butte, Mont.

THE necessity for mechanical ventilation of the Butte mines of the Anaconda Copper Mining Co. is due to a number of causes, all of which are incidental to the depth at which mining operations are now carried on. The main object to be accomplished, of course, is the reduction of the temperature and humidity of the air in the working places. Ventilation fans, both surface and underground, have been used for many years, but increasing depth has made the problem much more difficult. Further improvement in both ventilation equipment and methods, therefore, became necessary; and it is the purpose of this paper to describe the work planned and done under the improvement program.

When operations are conducted at a normal rate, about 10,000 miners are employed on two shifts, so that about 5000 men will be underground at one time, but as ventilation is necessary to reduce high temperature and humidity due, mainly, to natural causes, the quantity of air per man per minute is not a governing consideration in determining ventilation requirements.

Results obtained by various investigators indicate that the bad effects of a high $CO_2$ content in the air are not so great as has been generally supposed, provided that temperature, humidity, and air-movement conditions are such that excessive heat is removed from the body. In general, the air in the Butte mines is of sufficiently good quality, and only measures for the reduction of temperature and humidity, or increase of air movement, are necessary. The general subjects of mine resistance and coefficients of frictional resistance to the flow of air have been quite fully discussed, but wide variations occur in the figure given. By far the greater part of the determinations were made in coal mines, and almost nothing was available that had any bearing on the resistance of such entirely dissimilar workings as are found in metal mines. For these reasons, it seemed advisable to get more accurate information in regard to the mines directly affected by the work to be done, so resistance determinations were made of all important types of air courses.

Concrete water boxes for air shafts, which fit into corner of shaft compartment and offer minimum resistance to flow of air.

In practice, the static orifices of Pitot tubes were placed at measured distances apart in the shaft, drift, or crosscut, where the determination was to be made and were then connected by air-tight tube or hose to the U gage on which the difference in static pressure was to be noted. Velocity readings were then made with both Pitot tube and anemometer, and friction coefficients figured from the data obtained. For this purpose it was, of course, necessary to use workings in which there was a high velocity of air movement.

The coefficient $K$, which expresses, in pounds per square foot, the pressure necessary to overcome the resistance offered by 1 sq. ft. of rubbing surface at an air velocity of 1 ft. per min., as thus determined, is given for the following types of mine workings. In all cases, the area used in making the calculations was the

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clear area of the air course inside main timber, and the rubbing surface was assumed to be that which encloses the clear area.

For rectangular shafts of two or more compartments with open timber framing, from 0.000,000,007,2 up to 0.000,000,009,6; variations are dependent mainly on the condition of the timber, such as lagging.

For rectangular shafts in which each compartments is a separate smooth surfaced duct, from 0.000,000,001,4 up to 0,000,000,002,3.

For timbered drifts and crosscuts, about 5 by 7 ft. in the clear, from 0,000,000,007,7 up to 0.000,000,010,9; variations are dependent on whether the air course is straight or crooked.

For untimbered crosscuts, from 0.000,000,003,1 up to 0.000,000,004,4; variations in this case are also dependent on whether the crosscut is straight or crooked.

For the manway compartment of raises, almost any figure from 0.000,000,025 upward may be obtained, dependent on the condition of the raise.

These figures are based on gage readings that ranged from 3 to 15 in. and are believed to be fairly accurate, considering the limitations of the instruments used and the character of the problem. It was possible to note that the variations in resistance caused by the passage of a cage through the section of the shaft upon which the determination was made, also by a man standing and walking in opposite directions in a drift and by a mine car standing in a crosscut, the last being equal to about 40 ft. of the crosscut.

Nevertheless, as all determinations made with either Pitot tube or anemometer depend for their accuracy on the assumption that the flow of air takes place in straight lines normal to the plane in which the instrument is held, serious inaccuracies must occur because this assumption is unwarranted by fact. Nothing beyond an approximation in measurement is, therefore, possible, and accuracy is in the greatest degree dependent on the care used in making it.

In confined places, such as dead ends on crosscuts, drifts, or raises, the heat generated by blasting and lights and that given off by men's bodies raise the temperature of the air. Ventilation of such places is necessary to drive out powder smoke and maintain a supply of good air and to reduce temperature and humidity. For this service small blowers are used to force fresh air from the nearest source of supply, through canvas pipes, to the working face.

Inspection of ventilation conditions, together with the duty of making recommendations for their improvement, is entrusted to a ventilation and safety engineer at each mine. He is employed under the direction of the mine foreman, but to act in ventilation work in coöperation with the ventilation engineer. Repairs and renewals of canvas pipe and blowers, and the installation of doors, or other details necessary to carry out the ventilation system, are made on his recommendation to the mine foreman. Monthly reports made to the ventilation engineer include: A record of the temperature and humidity of the air at every working place in the mine; the conditions existing at all places ventilated by blowers and canvas pipe, with a description of the equipment used and its state of repair; recommendations in regard to improvements or other matters needing attention.

As a matter of convenience in recording information on the print the following conventional signs have been adopted:

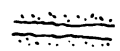

Air moving upwards, entering the level.

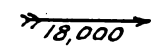

Air moving upwards, leaving the level.


Air moving downwards, entering the level.

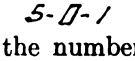

Air moving downwards, leaving the level.


Bars over the foregoing signs indicate that the air is not coursed directly to adjoining levels. The mine numbers of raises, or other working places, are given when necessary.


Filling, timber bulkheads, or other conditions permitting the air to escape from the sill.



Direction of flow of air, and volume in cubic feet per minute.



The first numeral is an abbreviation of the number of the level, the letter indicates that the stopping is a door, and the last number is the number of the door in reference to the particular level. Bulkheads, and brattices, may be similarly denoted by a difference in the letter.

## Mine Fires and Hydraulic Filling

By H. J. Rahilly, Butte, Mont.

MINE fires, in the Butte District, have been a source of trouble and expense for the past thirty years. While the actual fire area in most of the mines has been comparatively small, the handling of the gas has generally been a much larger problem than the actual putting out of the fire. The chief causes of these fires have been: defective electrical equipment, incendiarism or carelessness, and spontaneous combustion.

Fires from the first two causes have been numerous, but generally they have been discovered and extinguished before they became serious. Spontaneous combustion has been the cause of most of the large fires. Sufficient heat has been generated by ground movement, high rock temperatures, and decomposition, to set fire to inflammable materials; tarred ropes, canvas, dry timber, manure and hay. Also, the heat resulting from the oxidation of the fine broken sulfide ore is sometimes sufficient to set fire to the timbers.

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Prior to February, 1917, mine fires had been combatted by fighting the fire until it was extinguished or if, as so often happened, the fire was in inaccessible territory, the region was sealed and water introduced through diamond-drill holes put in from levels above. In that year, in fighting one large fire, it became apparent that any method of permanent sealing was going to be ineffective, because the ground was too badly broken and the use of water would be futile because it would form water courses in the stopes and would not spread out sufficiently to be of much value; therefore it was decided to fill this walled-off region with mill tailings. Prior to December, 1920. the tailing was taken direct from the Black Rock mill of the Butte & Superior Copper Co. Ltd., but when the mill was closed down, tailings were obtained by hydraulicking the tailing pond.

The following conclusions have been arrived at by the writer as to the operation and results of the filling:

1. This use of tailings will make possible the recovery of several million tons of ore in the Butte district.
2. It will extinguish the fire.
3. It will tend to eliminate high rock temperature.
4. It will eliminate gas.
5. It will help materially to increase ventilation.
6. It will tend to stop movement of the ground.
7. Material used is mill and flotation tailings consisting of 75 to 85 per cent. silica, and crushed so that 50 per cent. will pass 280-mesh screen. Little trouble is experienced in sluicing this material down a 3600-ft. flume on 2 per cent. grade, in 250 to 600 gal. of water per minute carrying from 20 to 50 per cent. of solids, by weight.
8. The wear on the pipe has been negligible; wrought-iron pipe for distribution laterals underground would serve better than cast-iron pipe, as it is cheaper and easier to handle, but the writer prefers cast-iron pipe in shafts and main distribution pipes.
9. Water drains through bulkheads and rock pillars, so that no great pressures are built up.
10. A rubber-lined pump has been tried at the tailings pond, but because of nails and small pieces of metal in the tailings, the rubber lining would not stand the service. Up to the present time, the use of this pump is still an experiment.
11. The success of the filling has depended on the use of fans, breathing apparatus, and the cement gun; without these the work would be difficult.
12. Filling of this character is particularly applicable to mine fires of large extent and long duration, where temperatures are high and the actual fire is inaccessible.
13. Under certain conditions, the filling might be used as ordinary mine filling, and to fill stopes that have been mined out, thereby excluding any possible chance of their catching fire.

## Power Distributing System for Deep Metal Mines

By C. D. Woodward, Butte, Mont.

THE Anaconda Copper Mining Co. purchases 25,000 kw. of electric power for its mining operations at Butte, Mont. This power is delivered over duplicate feeders in the form of 60-cycle, 2400-volt, three-phase current, to five compressor plants, where most of the energy is used for driving air compressors. At the compressor plants are located the switching apparatus for controlling the 2400-volt power and distributing it to the various mines. At these points, also, there are a number of motor-generator sets for converting the alternating current to 275-volt direct current for the haulage systems. Pole lines convey the power from the compressor plants to outdoor transformer substations at most of the mines. When it is not economical to distribute the power at the lower voltages in the mines, transformers and motor-generator sets are placed at strategic points underground.

All power is purchased on a maximum-demand basis, therefore there is installed at one of the compressor plants an eight-element totalizing graphic wattmeter. This instrument records simultaneously the value of all power taken at the numerous points of delivery, which not only eliminates the diversity factor but permits load dispatching between compressor and pumping plants, and thus materially reduces the maximum demand from the power system. Most of the mine hoisting is done by 90-lb. compressed-air winding engines, so that the air-compressor equipment for the winding engines and mining operations is quite extensive. Most of the compressors are directly connected to synchronous motors. The synchronous motors are designed for 80 per cent. leading power factor, thus facilitating power-factor correction of total mine load. By coöperation with the power company, the voltage of the power received at the compressor plants is constant.

In the mines, there are approximately 10,000 hp. induction motor and 4500 kw.-a. transformer capacity. It is the practice to install 2200-volt motors in the mines, except those rated below 50 hp.; there are in operation underground about 5000 hp., in the higher voltage motors, and approximately the same horsepower in motors wound for 440 volts. Approximately 50 per cent. of the motor load in the mines is required for pumping operations; the remainder is used for mine ventilation and haulage purposes.

In the early installations, lead or cotton braided armored cables were clamped by wooden cleats to the timbers of the mine shafts. A number of cable failures and fires resulted from this practice, therefore a number of improvements have been made. Cables installed in the pump compartments are always exposed and liable to an accident in the shaft. Where safety and reliability are required, electric cables should be put down through diamond-drill holes.

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## Electric Haulage Systems in Butte Mines

By C. D. Woodward, Butte, Mont.

PRIOR to 1902, tramming ore from stopes to shafts, in Butte mines, was done by man or animal power. Demand for greater tonnage and the need for more improved methods of tramming resulted in the installation of compressed-air locomotives in a few mines. These locomotives were not generally adopted, because of a number of limiting features. They were superseded by electric trolley locomotives.

There are now operating in the Butte mines of the Anaconda Copper Mining Co., 185 trolley-type locomotives, each of which has replaced five animals.

The haulage conditions in this company's mines have many advantageous features that are not always found in underground mine workings. The drifts and crosscuts are large, approximately 5 ft. wide by 7½ ft. high, and have curves of no less than 18 ft. radius; and the roadbeds of the drifts and crosscuts have a uniform grade of 0.5 per cent. in favor of the loaded trips. In all of the mines, except two, the track gage is 18 in., and all tracks in the main haulageways are laid with 25-lb. rails. The average haul is 1500 ft., but a number of hauls are approximately 3000 ft. long.

Usually a train consists of ten loaded, roller-bearing cars. Each car weighs, when empty, 900 lb. and holds 14 cu. ft. of ore, which weighs about 1800 lb., thus the total weight of a train, without the locomotive, is 13½ tons. Normally, ten trips of ten cars of ore each are required per shift of 8 hr. on each mine level; this does not include, however, the tramming of waste or supplies. Waste is generally hauled during the time the ore haulage is light, as the material is usually trammed against the grade from the shaft to the stopes for back-fill. During a working day, the locomotives are in service 16 hr., hauling an average of 245 loaded cars, and returning the same number of empties.

A mine locomotive with a drawbar pull of 750 lb. would perform the work that has been outlined. To resist the abuse to which a mine locomotive is always subjected, larger equipment has been installed. The trolley locomotives now in service have a drawbar pull of 1450 lb., a speed of 5.3 mi. per hr.; and weigh 3½ tons. The trolley wire is carried in an inverted wooden trough placed at one side of the tracks and made of 2 by 8-in. strips for the back and 1 by 8-in. boards on each side.

As the trolley wire is a fire hazard and a potential danger to the workmen and as it limits the use of a trolley locomotive, particularly in the gathering operation, the storage-battery locomotive has been installed in a number of the Anaconda mines. The first storage-battery locomotive put into operation demonstrated that it was a success and, as a result, thirty additional machines were purchased, and most of them are in operation. The total weight of the locomotive is 4½ tons. It is rated at 1500-lb. drawbar pull at 3½ mi. per hr. on level track, with a maximum drawbar pull of 2500 lb. for starting and accelerating.

The cost of a trolley wire and track-bonding installation on the long hauls is about equal to a set of storage batteries for a locomotive, hence there is little difference in cost between a trolley locomotive and a storage-battery locomotive installation. The cost of maintenance of the two types of installation has been in favor of the latter, as the labor necessary to keep the trolley wire in alignment with the rails, due to the movement of ground in a number of the mines, and the constant repairing of the guard strip over the trolley wire, involves large expenditures.

There are now operating in the mines 22 storage-battery locomotives, hauling an average of 245 loaded cars and returning the same number of empties in a 16-hr. day.

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## Electric Signal Installations in Butte Mines

By C. D. Woodward, Butte, Mont.

AT THE mines of the Anaconda Copper Mining Co., the movement of all mine cages or skips is under the direction of a station tender, who rides on the cages when men or supplies are being lowered or raised. When ore is hoisted, he is stationed at a skip pocket for loading and despatching the skips.

For the station tender's use, two signal systems are installed in each hoisting compartment, and he is the only employee authorized to use them. One system is known as the "AC" or station bells, as it is operated from the 110-volt, 60-cycle, power service; the other system, called the "DC" or shafts bells, takes its energy from closed-circuit primary batteries. As a supplement to the two main signals, a buzzer system is installed. The general arrangement is similar to the main signal, except that there is a mine buzzer at each station. When a signal switch connected into the buzzer system is pulled down, all buzzers are operated, thus notifying the station tender that he is wanted at some particular level.

Placed on the station posts, and within easy reach of the men on the cages, are the signal pull switches for the main signals. The station, or "AC," pull switches are furnished with a short rope, while the shaft, or "DC," pull switches are equipped with ropes that extend down the shaft past the next station. To avoid all confusion in the use of the three signal systems, a standard arrangement has been adopted in all mines for the location of the pull switches. The accompanying illustration shows the position of the pull switch at the stations for the main signal systems, but does not show the buzzer pull switch; this is fixed to the roof timbers about 25 ft. back from the shaft. If the skip pockets are a considerable distance below the station, a pull switch for each main shaft compartment is connected to the "AC" system and placed at this point. However, if the distance is short, a light cord

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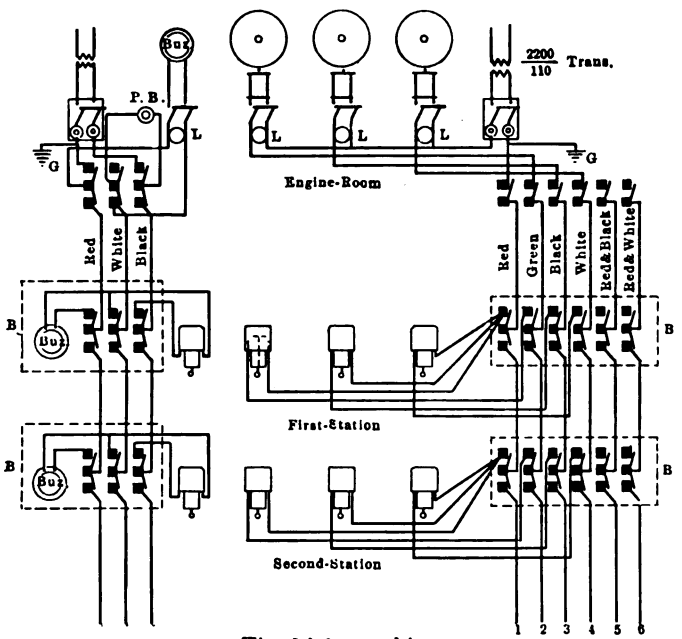
is attached to the station pull switches and dropped down to the skip pocket. To facilitate the sending of signals from any point in the shaft during the repairing or inspection period, the long rope hung from the "DC" pull switches at the stations is used.

On one side of the engineer's stand are three bells for the three sets of station pull switches; on the other side are three additional bells for the three sets of "DC" shaft pull switches. The bells have different tones so that the engineer can tell whether the signal is sent from either of the main shafts or the auxiliary shaft. In addition to these six bells, there is a buzzer operated by the buzzer signal system.




STANDARD ARRANGEMENT OF PULL SWITCHES.

In the "AC" system, each bell on the engineer's platform is connected in parallel with a lamp, and in series with a double-pole switch. If one of the signal wires or station pull switches becomes short circuited or grounded, thus causing the single stroke bell to be held up, it can be readily disconnected from the circuit. The lamp, however, will remain lighted and indicate when the trouble is removed. The buzzer system also has this arrangement, except that no lamp is used; but a push button is provided on the engineer's platform so that a return signal may be despatched to each station in the mine, which permits the engineer to call the station tender.

Starting from the engineer's platform, where the signal bells, lights and buzzer are located, three cables extend into the mine and terminate in junction boxes at the first station. From this point the cables are continued from station to station, passing through junction boxes. Each main signal cable contains six flexible No. 12, A.W.G. conductors, while the buzzer cable has three No. 8, A.W.G. flexible conductors.

The layout of the signal systems and the special apparatus described has been developed after considerable study to meet the service conditions in the Butte mines.

## Steam-shovel Operation by Phelps Dodge Corporation

By H. M. Ziesemer and George Mieyr, Bisbee, Ariz.

STEAM-SHOVEL operations may logically be considered under the following major subdivisions: breaking ground, shoveling, haulage, dump maintenance, and sampling. The discussion of methods and cost in this paper follows this outline, with a brief description of equipment used in the operation.

In breaking the material for rapid handling by the shovels, a combination of bank and toe holes is used to prepare the ground for the powder charge. The bank holes are put down by churn drills. The toe holes are put in with the Burley machines. The average footage per shift for the air drills, in all classes of ground, is 27 feet.

The arrangement of the holes on established benches of 60-ft. height is given. The toe holes are depended on to give the required bench advance at the toe and to maintain a level bench floor. The function of the bank holes is to slope the bank, lessen the burden on the toe holes, and to make the bank safe for the shovel to go under. A slope of 50° is considered desirable and is maintained as nearly as is practicable.

The following table gives the yearly average performance of churn drills, in feet per 8-hr. shift, and cost per foot:

| Year | Feet per Shift | Cost per Foot |
|---|---|---|
| 1918 | 12.5 | $1.74 |
| 1919 | 20.0 | 1.14 |
| 1920 | 24.2 | 0.94 |
| 1921 (9 mo.) | 31.2 | 0.55 |

Bank holes are sprung heavily to take a charge of from 300 to 800 lb. of powder, depending on the nature of the ground. Cordeau Bickford, an exploding fuse, is used as a detonator. The toe holes are sprung to take a charge of from 75 to 150 lb. of explosive and are loaded and fired in strings, the number of holes depending on conditions.

In general blasting operations, it may be said that distributing the powder uniformly through the ground would make finer breaking and would save delays in shoveling. However, the comparative cost of drilling and loading holes bored by churn drill or air drill must be balanced in deciding on a method of shooting.

The height of bank affects both methods of shooting and shovel results. A gelatine 40 per cent. powder, 1⅛ by 8-in. sticks, was used in springing holes and shooting boulders. Both nitro-starch and ammonium-nitrate powders have been used in bank and toe holes. The following figures give the powder efficiency, in

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terms of solid yards per pound of powder used, and the cost per yard broken:

| Year | Solid Yards per Pound | Cost per Yard |
|---|---|---|
| 1918 | 1.43 | $0.158 |
| 1919 | 1.72 | 0.115 |
| 1920 | 1.97 | 0.100 |
| 1921 | 2.12 | 0.101 |

The operating crew consists of nine men: engineer, craneman, fireman, and six pitmen. The loading capacity of the shovels in favorable material has never been reached. The record 8-hr. shift is 124 cars, or about 2350 solid cubic yards. The following table gives the average yards per shovel shift, gallons of fuel oil per yard, and the cost per solid yard:

| | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|
| Solid yards per 8-hr. operating shift | 582 | 828 | 769 | 1038 |
| Gallons of fuel oil per solid yard | 0.81 | 0.65 | 0.60 | 0.56 |
| Cost per solid yard | $0.236 | $0.181 | $0.157 | $0.130 |

The broken material is separated into four products, as follows: direct smelting ore, milling ore, leaching ore, and waste. To date, waste has been the principal material handled, although small tonnages of direct smelting ore have been shipped to the smelters at Douglas, about 180,000 tons of milling ore have been placed in stock pending starting of the concentrator, and 375,000 tons of low-grade ore have been placed on the dump for heap leaching. In the earlier stages of the operation, it was necessary to locate waste dumps on adjacent hillsides.

The following table gives the cubic yards hauled per locomotive shift, the gallons of fuel oil used per yard, and the cost, including the maintenance of the dumps:

| | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|
| Solid yards per 8-hr. operating shift | 237 | 338 | 361 | 450 |
| Gallons fuel oil per solid yard | 1.45 | 0.95 | 1.03 | 0.87 |
| Cost per solid yard | $0.333 | $0.239 | $0.254 | $0.177 |

Seven shovels are regularly used for loading the broken material. They are all the Bucyrus Co. Model 88 C, which are standard machines designed for such work. They weigh 103 tons, are equipped with 3.5 yd. dippers and locomotive boilers. The maximum lift is about 75,000 lb.

Due to the hard ground and the high banks, considerable damage was done to the main frames, so all had to be reenforced over the front trucks. Also, the size of the A-frame legs was increased from 6 to 7 in. It is proposed in the future to equip all shovels with locomotive-type superheaters.

In starting a large shovel job, heavy costs are to be expected while building up an organization; in this case, the troubles were increased by the shape of the hill and the difficulties of getting the first benches removed. The following table gives the number of solid cubic yards moved per man-shift and the labor costs per yard:

| | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|
| Solid yards moved per man-shift | 7.84 | 11.74 | 12.02 | 15.28 |
| Cost per solid yard, labor | $0.590 | $0.387 | $0.419 | $0.312 |

The following table gives the average yearly cost per solid yard:

| | 1918 | 1919 | 1920 | 1921 |
|---|---|---|---|---|
| Breaking ground | $0.357 | $0.239 | $0.214 | $0.173 |
| Steam shovels | 0.236 | 0.181 | 0.157 | 0.130 |
| Haulage expense | 0.333 | 0.239 | 0.254 | 0.177 |
| Dump expense | 0.040 | 0.031 | 0.031 | 0.023 |
| Miscellaneous expense | 0.008 | 0.008 | 0.027 | 0.016 |
| Total | 0.974 | 0.698 | 0.683 | 0.519 |
| Monthly labor bonus | ..... | 0.004 | 0.023 | 0.029 |
| Total, Direct | 0.974 | 0.702 | 0.706 | 0.548 |

The improvements in costs and increase in efficiency are due both to improvement in the physical condition of the ground handled and the development of a good working organization. The paramount factor in an organization is efficient coöperation. The spirit of coöperation and the incentive to efficiency have been given the foremen, bosses, and men by the posting of graphic charts giving the daily cost and labor efficiencies in all departments. Another factor is the labor bonus based on the yardage per man shift whereby every employee benefits on a percentage basis.

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## Handling Ore in Mines of Butte District

By H. R. Tunnell, Butte, Mont.

EVERY ONE connected with a mine knows that it is hard to keep down the costs of moving ore from the place where it is broken to the shaft or portal. Considered broadly, the subject of handling would cover all work done in a mine, but here it has been limited to handling ore in stopes and drifts, through chutes, and on levels. Good ventilation and a strict enforcement of rules for the prevention of dust safeguard the health of men and lower transportation costs.

About two-thirds of all the ore mined in Butte comes from square-set stopes. The shoveling and timbering costs in square-set stopes are high when compared with the costs in the rill stopes. The number of chutes is limited by the tendency of the ground to cave; if carried too close together the stope is weakened. Small stopes, or blocks as they are called, are used in working a large orebody, as they stand better and allow more of the ore to be handled on slides.

The rill stope is growing in favor throughout the district. These stopes are filled with waste from a chute at the upper end and floors are laid on this waste. The ore is drilled and blasted to the floor, which is from 40° to 45° to the horizontal, and runs to the grizzly at the lower end of the stope at a minimum cost for handling.

The timbered rill is a rill stope with square-set timbering; it is used where the vein is too wide and the back is considered unsafe for the open rill method.

The back-filling stope is worked without timber between chutes. The floors are level, as in the square-set stopes, yet rest on the waste filling as in the rills.

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Except where the veins are very flat, under 50°, the back-filling stope has been supplanted by the open rill.

### Shoveling

Laying good floors and slides and careful sorting on the grizzlies are more important in a stope than using a shovel to put rock into the chute. Actual shoveling costs vary much for the different mines, as well as for individual stopes in any one mine.

Comparative shoveling costs for different methods of stoping are:

| | |
|---|---|
| Square-set stoping | 100 |
| Rill stoping | 75 |
| Timbered-rill stoping | 85 |
| Back-filling stoping | 120 |

The results show that the rill stope is most economical; the timbered-rill stope makes the application of the rill principle more general. The back-filling stope is used to meet special conditions. The square-set stope is still used in heavy ground and where large orebodies are to be worked in blocks. From 12 to 18 tons per man shift are shoveled in drifts and crosscuts. A No. 2 shovel with a straight handle 42 in. long is used throughout the district. Short shovels with a D-shaped handle were tried but were not liked by the miners. The tools used in shoveling are:

No. 2 square-point shovel, 42 in. handle
No. 2 round-point shovel, 42 in. handle
No. 4 picks
12 lb. rock hammers
No. 4 steel wheelbarrows
Anaconda type mine cars

Grizzlies are timber or steel rails spaced 4 to 10 inches.

### Handling Ore on Levels

Underground haulage is done by men, animals, or power. The amount of ore to be handled, length of haul, size of haulway that can be readily maintained, and the grades to be overcome determine which method is best adapted to any level.

Cars of the same type but of two sizes are used. The Anaconda No. 1, used in two mines, is 20-in. gage, holds 16 cu. ft., stands 3 ft. 10 in. above the rail and is 2 ft. 2 in. wide. The Anaconda No. 2, used in twenty-eight mines, is 18-in. gage, holds 14 cu. ft., stands 3 ft. 10 in. above the rail, and is 2 ft. 0 in. wide. These cars are small for motor haulage but, because of the heavy ground caused by settlement of stopes and sills in the wide orebodies, it has not been considered advisable to change to a larger car. Of the 7000 cars in use, 3000 have roller-bearing wheels, which will be the standard equipment.

For hand tramming, 12 to 16-lb. rails are used; for animal haulage, 12, 16 and 25-lb. rails, and for locomotive haulage, 25-lb. rails.

There are wide variations in the size and design of chute mouths at the different mines, the sizes run from 22 in. wide by 24 in. high to 36 in. wide by 20 in. high.

### Stations

The manner of handling ore trains on the stations is dependent on whether skips or cages are used to hoist the ore. If skips are used, the skip pockets are often large enough to store from 50 to 150 tons, although in some mines pockets holding one skipful are used and in others, on levels producing only a small tonnage, the cars are dumped directly into the skips. The cars from the trains are handled by station tenders (men working on cages) when the ore is hoisted by cage, dumped into the skip direct, and when pockets holding but one skip are used. With large skip pockets, the men on the train dump cars into the pockets; or if the tonnage is large enough a man is kept on the station to dump the cars. The cars are dumped through holes covered by a grizzly with opening not less than 10 in.; in some cases, as small an opening as 4 in. is used to sort out waste.

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## Safety Practice for Hoisting Ropes

By R. M. Raymond, New York, N. Y.

THE Mining Section of the National Safety Council recently sent out a questionnaire to operators, regarding the class of rope used, specifications required or obtained, factors of safety observed, methods of fastening ropes, lubrication, inspection and points observed when rope is to be discarded. The answers received from this questionnaire, largely from metal mines, give interesting information, from which recommendations for safety practice on hoisting ropes may be drawn.

The depth in the majority of cases noted is from 1000 ft. to 1500 ft. and records come from a number hoisting from depths of 2000 to 3000 ft. Hoisting is generally done in balance, with a few companies using counterweights.

The range of loads varies from 7 to 17 tons and greater in a few cases, with a balanced weight of 4 to 7 tons.

The size of drums and size of sheaves are generally in accordance with recommendations of rope manufacturers. Only one-half of the operators use grooved drums; one, the Sulphide Corpn., New South Wales, uses wood-lagged drums. Very few operators have drums capable of holding all the rope in a single wrap. Cone drums or cone and cylinder drums, in the mines heard from, are very rare.

A few mines of shallow depth use a small drum and large-sized sheave. While this may be allowed, and in some cases is all right, the size of drum and sheave should be fully equal to that recommended by the rope manufacturers and should be at least 60 to 100 times the diameter of the rope used, or one thousand times the diameter of the largest wire in any of the strands.

Operations show two wraps wherever possible, and not more than three wraps on the drum; the choice of

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several would be not more than one wrap if possible, and not more than two as good practice. A few operators, though too few, give importance to the distance at which the engine is set from the shaft and the fleet angle between sheave and drum.

The matter of overwind and underwind of ropes perhaps receives too little attention. The experience of operators in South Africa, according to Vaughan, of the Mines Department, indicates that the rope which underwinds wears more rapidly than the overwind rope by 20 per cent., and that the average life of rope is prolonged by alternating the ropes on the drums.

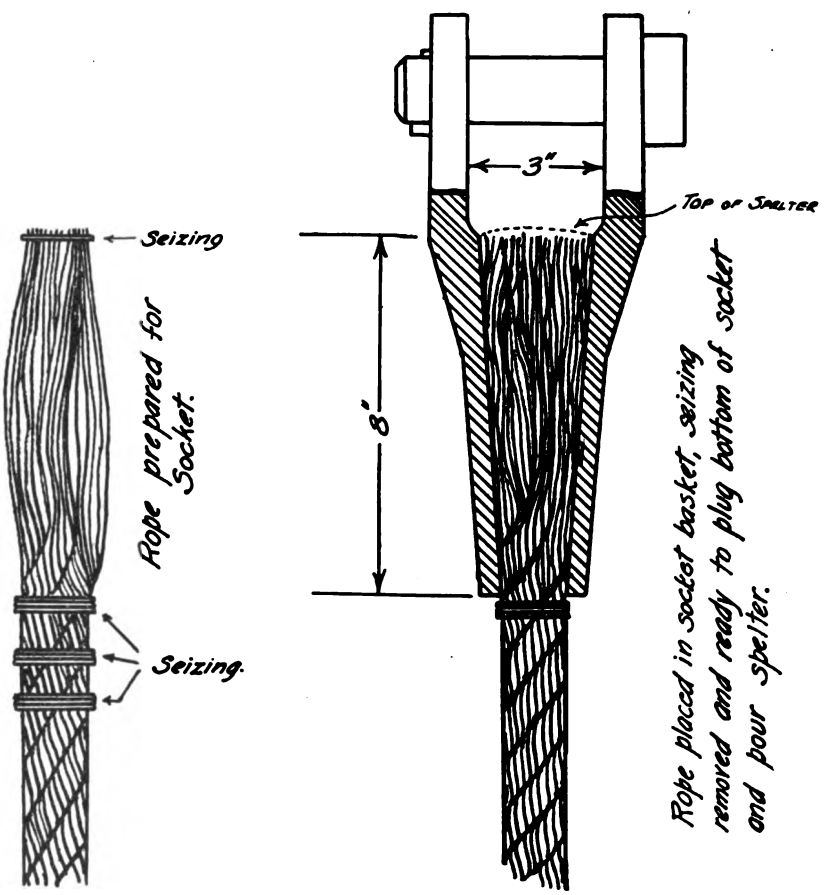
In a majority of cases, sheaves are cast iron, turned out true, 1/16 or 1/8 in. larger than the size of rope used. Others use special lining of cast iron, which is removable; the best type of this is the Nordberg sheave. Several companies use hardwood blocks, preferably maple. A few use hemp packing at first or to fill the groove when the sheave becomes worn. It would seem that more attention might be given to the material of sheaves and to the question of linings.

Ropes vary in size from 1 to 1½ in., generally 6 × 19, hemp center. A majority of the operators use the higher class rope, plow steel or special improved brands, and a few use a flattened strand, 6 × 25. A number prefer the Lang lay, which is the favorite with larger operators hoisting from the greater depths. Lang lay ropes are used in nine cases out of ten in South Africa; they are in very general use in Australia, and their use is becoming more general in this country.

Few companies stipulate specifications for rope; reliance is placed on the tensile strength given by the manufacturers. Preference is shown for plow steel by the larger operators, with the understanding that the tensile strength of the wires is, or approaches 200,000 lb. per sq. in. The International Nickel Co. calls for tenders from manufacturers, gives full description of working conditions, and asks manufacturers to recommend rope for these conditions, with complete description. It requires a factor of safety of seven for hoisting ore and a factor of safety of ten for the man hoist. The United Verde mine stipulates low-phosphorus steel, high carbon and manganese, with a tensile strength of the wires of 200,000 lb. per sq. in. The Copper Range Co. stipulates 1¼-in. plow steel, 6 × 19, regular lay; 58 tons tensile strength, and on test has found the rope to have a strength of 75 tons. The Broken Hill mine uses 1¼-in., 6 × 19, Lang lay and specifies a breaking stress of the rope of 60 tons and best flexible plow steel or its equivalent. The Anaconda company does not specify particularly, but uses improved plow steel in all cases

While the manufacturers' recommendations seem to be generally satisfactory, it is most important that purchasers give clearly their working conditions, nature of shaft lining, attention given to timbers and guides, the factor of safety desired, whether mine water is acid or not, and whether harmful gases are encountered in the lower part or any portion of the mine. The rope should be stored under cover, in a cool place, properly oiled and not left on the ground.

The Canadian mining law requires a certificate from the manufacturer showing date of manufacture, size, weight, number and size of wires, class of core, breaking stress of steel from which wire is made, and estimated breaking load of rope. This certificate is recorded in the "Rope Record Book" and additional data kept of operation of rope when in use at the mine.


Seizing
Rope prepared for Socket.
Seizing.
3"
Top of Spelter
8'
Rope placed in socket basket, seizing removed and ready to plug bottom of socket and pour spelter.

CORRECT METHOD OF SOCKETING WIRE ROPE, GREAT BOULDER PROPRIETARY GOLD MINES.

The factor of safety stipulated or estimated varies considerably, generally that estimated by the manufacturers in supplying rope is considered satisfactory, and is five to six for new rope. Factors of safety for worn rope vary from three and one-half to five, and these variations for discarding rope correspond somewhat with speed and depth.

None of the state laws in this country indicate any factor of safety. The Canadian mining law stipulates a factor of safety of six in shafts less than 2000 ft. deep; and in shafts 2000 to 3000 ft., not less than five.

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Speed in the shallow shafts submitted is from 600 to 1000 ft. per min. for ore, and in deeper shafts 1600 to 3000 ft. per min. Speed for hoisting men in almost all cases is reduced to 400 to 600 ft., though in a few cases it runs as high as 1000 ft. per min. Acceleration varies considerably, depending on depth. The accompanying table shows acceleration practiced by several of the important operators.

*Acceleration in Various Mines*

| | Shaft | Average Length of Haul, Feet | Maximum Hoisting Speed, Ft. per Min. | Acceleration, Ft. per Sec. per Sec. | Length to Reach Max. Speed, Feet | Time to Reach Max. Speed, Seconds |
|---|---|---|---|---|---|---|
| N. J. Zinc Co., Franklin, N. J. | Inclined | 915 | 3000 | 3.33 | 375 | 15 |
| Inter. Nickel Co., Creighton, Ont. | Inclined | 1600 | 1100 | 2.33 | 260 | 15 |
| Witherbee-Sherman, Mineville, N. Y. | Inclined | 1000 | 1200 | 1.33 | 150 | 15 |
| Copper Range Co., Painesdale, Mich. | Inclined | 1500 | 2360 | 2.48 | 130 | 10 |
| Republic Iron and Steel Co., Birmingham, Ala. | Inclined | 5400 | 2200 | 1.47 | 459 | 25 |
| Sulphide Corp., N. S. W., Australia | Vertical | 825 | 3650 | 5.06 | 300 | 15 |
| Calumet and Arizona, Warren, Ariz. | Vertical | 1500 | 1600 | 5.33 | 70 | 5 |
| United Verde Copper Co., Clarkdale, Ariz. | Vertical | 850 | 2000 | 4.7 | 115 | 10 |
| North Butte Co., Butte, Mont. | Vertical | 3600 | 2700 | 2.53 | 400 | 17 |
| Great Boulder Prop. Boulder, W. A. | Vertical | 2000 | 2000 | 5.85 | 95 | 6 |
| Old Ben Coal Corpn., Frankfort, Ill. | Vertical | 475 | 3600 | 12.00 | 150 | 5 |

Compared with the draft of the new mining law, the speeds for hoisting and accelerating speeds practiced by the different companies do not show any excess over the speeds recommended.

Method and frequency of inspection of ropes vary from daily inspection of terminals, including wraps remaining on drums, to weekly inspection. Fully 70 per cent. of the operators make inspection daily, and one makes inspection three times a day when hoisting men.

There is considerable diversity of practice in limiting the length of life of ropes. Several operators discard rope when the wires on the outside of the strands are worn to less than 60 per cent. of the original area, and when inspection shows signs of corrosion. Others take more particular note of the number of broken wires. One company discards rope when the number of broken wires in any consecutive 10 ft. exceeds 10 per cent. of the total wires in the rope; another very careful company condemns the rope when twelve wires per foot are found, or if the wires be pitted and can be pried out of place easily, even if no broken wires are found; another discards rope when 60 to 70 wires are broken in one strand. One company finds that a decrease of ¼ in. in diameter renders the rope unserviceable and cuts grooves in the sheaves; another company abandons the rope when a decrease of 3/16 in. in diameter is shown or when seven wires are broken in any one strand. The Anaconda Copper Co. discards when not more than 20 per cent. of the strength of the rope is used up by abrasion and broken wires. The Sulphide Corpn. generally discards its 6 × 7 rope when one wire in any way shows fractures; even if apparently in good condition, rope is discarded after two years service. One iron company turns the rope end for end every six months and discards it after a use of twelve months. The International Nickel Co., which takes special care of its ropes, abandons them after two years use, even if rope is apparently still in good condition.

## Wire Rope and Safety in Hoisting at Butte Mines

By W. N. Tanner and F. C. Jaccard, Butte, Mont.

THE wire-rope hoisting conditions at the mines of the Anaconda Copper Mining Co. in Butte, Mont., are very severe because of the conditions under which it is necessary to operate. A study was made, in the fall of 1919, for the purpose of changing these conditions in order to obtain longer rope and sheave life. There are at present, in Butte, hoisting engines equipped with wire rope as follows:

9 main hoists using flat ropes.
7 main hoists using 1½-in. rope.
5 main hoists using 1¼-in. rope.
6 shafts using 1⅛-in. rope.
2 chippy hoists using 1¼-in. rope.
9 chippy hoists using 1⅛-in. rope.
15 shafts using 1-in. rope.
7 shafts using ⅞-in. rope.
1 shaft using ¾-in. rope.

In addition, there are a number of sinking engines using ⅝-in., ¾-in., ⅞-in., and 1-in. rope.

The flat ropes run from ½ by 7½ in. to ⅜ by 4½ in. and are used on the older hoisting engines, which are set comparatively close to the shaft. Because of swelling and moving ground at some of the shafts, these ropes present certain difficulties in operation that are more pronounced than with round ropes; they are, therefore, being superseded by round ropes as newer engines are being installed. They are, however, much more easily inspected and repaired than round ropes.

In general, the practice in Butte is to use hoisting engines equipped with 12-ft. cast-iron drums, smooth faced, for 1½-in. rope and 6-ft. cast-iron drums, smooth faced, lagged with ⅜-in. steel plate for 1¼, 1⅛ and 1-in. rope on main and chippy shafts. Cast-iron head sheaves, 12, 10, and 6 ft. in diameter, with grooves machined 1/32-in. greater radius than the radius of rope, are used. Special steel ropes, either regular or Lang lay, according to conditions, are used; they are designed to withstand excessive abrasion and are wound on

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drums in from two to four layers. The use of straight-faced drums has been general throughout the Butte district and is one of the conditions that tend to make rope service severe. On some hoists, the left rope is the overwind; on others, it is the underwind.

The head sheaves are so located that a line through the center line of the sheaves and parallel with the center line of hoist will strike the drum from ½-in. from the inner flange, as at the Pennsylvania hoist, to 15½-in. from the inner flange, as at the Neversweat hoist. The space between this line and the inner flange must be filled with rope at all times, for, if unwound in operation, this portion of the rope will not wind uniformly when hoisting the load. The sheaves are lined so that the centers of the grooves are in line with the center of the drums.

Considerable thought has been given lately to the subject of equipping the engines with grooved drums because of the easier rope conditions, to be obtained from these drums. Because of the lack of ground around some of the shafts, and other local conditions, the fleet angles vary from 1° 6′ to 1° 27′, for hoists having 6-ft. drums and 1¼-in. rope, and from 1° 12′ to 1° 53′ for hoists having 12-ft. drums and 1½-in. rope. The two main hoists with 6-ft. drums and 1⅛-in. rope have fleet angles of 1° 10′, 1° 24′.

The head sheaves are made of cast iron 6, 10, and 12 ft. in diameter, with the grooves machined to a radius 1/32 in. greater than the radius of the rope, and are carefully balanced to run perfectly true. Semisteel sheaves were tried but abandoned because it was impossible to get the material in the sheave uniform.

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## Use of Wire Rope in Mining Operations

By James F. Howe, Worcester, Mass.

EVERY user of wire rope is desirous of information that will enable him to determine whether the performance of any particular piece of rope is satisfactory, and what conditions can be changed so as to increase the life of a rope. In most cases, it is far from easy to analyze the conditions of service and tell which is the greatest factor in determining the life of wire rope. If we start on a layout for an entirely new rope system, the task of making conditions satisfactory is simplified so far as the engineering details are concerned, but if the plant requiring wire rope is in operation, any change is likely to involve the expenditure of considerable money to replace and change over machinery that must be kept in constant operation, because a large monetary loss will result from a shutdown for even a few days. Often wire rope is kept operating under bad conditions, as the user figures that it is cheaper and quicker to replace the rope than to make alterations in the hoisting machinery.

Regular-lay and Lang-lay forms of rope construction are both old and both have their advocates. In Great Britain, Continental Europe, and South Africa, Lang-lay ropes constitute probably 80 per cent. of all used in mining. In the United States, probably 90 per cent. of all ropes in use are of regular lay.

In a Lang-lay rope, the wires in the strands and the strands in the rope are twisted in the same direction, giving the rope the characteristic appearance of being loosely twisted. Each individual wire appears on the surface of the strand for a longer distance than in the case of regular-lay rope. The worn spots on any wire are longer and such ropes appear to wear down farther than on a regular-lay rope. In a regular-lay rope, the wires in the strands have a left-hand lay and the strands in the rope have a right-hand lay. The rope has the appearance of being more closely twisted or laid together. A worn regular-lay rope exposes more worn crowns per foot but the worn spots are shorter.

If a Lang-lay rope is twisted in a direction to unlay the rope, the wires in the strands will untwist at about one-third the rate of the untwisting that occurs in the rope proper, assuming the same angle of lay for each. As a result of such untwisting, the outside wires of the strands are loosened, the amount depending on the amount of untwisting. Excessive stretching of a Lang-lay rope will produce about the same effect. The only opposition, therefore, to the continued untwisting of a Lang-lay rope is the stiffness of the individual wires to the torsional stress tending to untwist them. If a Lang-lay rope is twisted in a direction to shorten the lay of the rope, there is at the same time a shortening of the lay of the wires in the strands equal to about one-third of the shortening of rope lay. The result of this tighter twisting of the lay is to produce a double shortening of the rope; consequently, a powerful force is exerted against a shortening of the lay compared to a weak force opposing the untwisting action. For this reason, a swivel on a Lang-lay rope will often cause undue untwisting.

A force tending to untwist the regular-lay rope meets violent opposition because the wires in the strands tend to twist together by an amount equal to about one-third of the twisting of the rope, instead of untwisting as in the case of the Lang-lay. When the operation is reversed and a regular-lay rope is twisted together, the wires in the strands tend to loosen up.

Inasmuch as most wire ropes in service tend to lengthen in lay, or stretch, it is obvious that it is the behavior of Lang-lay and regular-lay ropes to the untwisting forces that is of most importance to rope users, as this is the action that occurs most frequently in actual service. The question, therefore, as to the adaptability of Lang-lay or regular-lay to any rope installation must be settled first on whether both ends of the rope are fast at all times. If they are, no harmful untwisting should occur that would deform the Lang-lay rope.

In the case of a shaft rope, safety demands that splicing must never be used; but on mine haulages, splicing

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occurs frequently as worn sections are replaced by new ones. The lack of familiarity with the splicing of Lang-lay rope is one of the drawbacks to its more extensive use in the United States.

If a wire rope drags or rubs, as frequently occurs on an incline or haulage, then in general Lang-lay rope will give the best results. Also, in cases of severe overwinding on hoisting drums, the Lang-lay rope will frequently give the best service. One fact, however, must not be overlooked, foreign rope practice on Lang-lay rope application is to use the largest possible diameter of sheaves and drums, which of course has a decided effect on the whole problem.

The most common method of attaching a wire rope to a drum is to pass the end of the rope through a hole in the drum and either clamp it to the drum with U-bolts or clamps, or to pass the rope around the drum shaft inside the drum and fasten the end back on itself. At least three complete wraps are usually left on the drum when the cage is down to the lowest level of the lift. This method seldom gives trouble, but in a few cases there has been a slight creeping of the rope at the point where the rope goes through the drum as the load comes off with the cage resting on the bottom, causing wear at this point of the drum.

A better method, and one requiring less rope, would be to cast a zinc cone on the end of the rope after it has passed through the drum and have the drum recessed so as to receive the end of the rope thus treated; then no slippage can occur.

For fastening the end of the wire rope to the cage or skip, different methods are used. The ideal cage fastening should develop the full strength of the rope. Of what value is a high-grade rope designed to give a safety factor of 6 if the end fastening or attachment will give only 66 per cent. efficiency?

The various methods of making end fastenings on cages and skips may be classified as follows: wire rope clamps for forming small loop with thimble, wire rope clips for forming small loop with thimble, eye spliced in rope for forming small loop with thimble, and socket attachment.

A new method, the result of research work on the part of rope manufacturers seeking a more reliable method of socketing, is simple, cheap, and possesses the highest efficiency known to the rope art. It is rated at 100 per cent. The important points are to clean the wires thoroughly, to flux them with acid, and to use zinc, never babbitt or lead. Zinc adheres to the wires firmly; in fact, the wires are galvanized into a solid mass. This new method of socketing is fully described in Bulletin No. 75, U. S. Bureau of Mines, and is used exclusively by mines in South Africa for all their rope attachments.

The safety factor in a wire rope will be reduced by the following causes: (1) External wear; (2) breakage of individual wires; (3) corrosion by acid water, alkali water, electrolysis; (4) loss of elasticity; (5) fatigue in metal composing wires from regular or reverse bending, load variations caused by shocks due to starting and stopping or overloading, torsion at or near attachments.

## Safety Devices for Mine Shafts

By Rudolf Kudlich, Washington, D. C.

THE problem of eliminating the hazards of hoisting in mines has been with us since the industry passed its earliest stages, when coal and ore could be won from surface working and tunnels. At first, safety devices were introduced as means of decreasing the amount of labor necessary to produce the material, or to increase the amount that could be obtained from a certain opening. From such beginnings accident prevention in mine hoisting advanced with the importance of the industry, until at present hoisting compares favorably with other branches of the mining industry with reference to safe practices.

It is necessary to place our reliance mainly on mechanical devices to prevent accidents, and to depend as little as possible on laws, rules or other means involving the human element. This does not mean that we hope to install mechanical devices that will absolutely protect the workman against himself, or that it is possible to perfect appliances that will remain operative year after year without care; but better results can be expected from such devices, which will protect unless they are deliberately rendered inoperative, or are allowed to deteriorate to such an extent that they will not function.

To find where the greatest need of devices to prevent accidents exists, statistics should be studied to find how the accidents occur. Unfortunately, statistics covering accidents in metal mines are very incomplete so that our assumptions must be based entirely on the number and causes of accidents occurring in coal mines. These assumptions will not be far wrong for metal mines, as the methods employed are not radically different. The principal hazards, falling down the shafts or being struck by objects falling down the shaft, or while riding on cages, exist in both cases. Tables are given showing the number and kind of accidents and their causes for a period of 44 years.

The greatest number of shaft fatalities is due to falling down the shaft. Properly protected shafts, entirely enclosed by fence or gate are becoming common.

Of 1001 accidents, 145 were caused by objects falling down shafts. There are two methods of eliminating such accidents—preventing objects from falling and keeping men out of the danger zone. A few of the objects fall from the surface, where they are accidentally thrown or fall into the shaft; a few fall from timbers in the shaft, where they have lodged at some time; but the majority are pieces of coal or rock falling from the cars as they are being hoisted or dumped at the top.

Foreign objects can generally be prevented from

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falling into the shaft at the surface, by suitable fences and toe boards, but those falling from timbers can be eliminated only by unfailing care on the part of the shaft repair men and inspectors.

The best remedy is to keep the men out of the danger zone at shaft landings; this is quite possible by the use of automatic caging devices. These devices are of benefit in so many ways that it is hard to understand why they are not more generally installed. From the safety standpoint, the automatic device eliminates entirely the need of men working directly at the shaft when hoisting coal. The empty cars are automatically released from the cage, when it is landed, and levers set at a distance from the shaft control stop blocks which, when released, allow the loaded car to run by gravity on the cage, where it is held by self-operating blocks.

The third largest class of hoisting accidents are those caused by overwinding. These can also be prevented by mechanical devices, though more complicated apparatus is required than in either of the preceding cases. This apparatus has the advantage, however, of being well protected from the weather and from dirt, and is under the direct care of the hoisting engineer, a man familiar with machinery and able to properly maintain it.

It may be questioned whether accidents occurring while sinking shaft should be included in shaft accident. This work is usually done by contract, and the methods employed are not usually under the control of the mine management; in many states, the work is not under the control of the mine inspector. I might say, however, that the principal offender is the crosshead, or billy. This is usually a simple wooden frame traveling between guides to steady the rope to prevent the bucket from swinging. As a rule, the crosshead simply rests on clamps on the rope, so that the rope is free to pass through the crosshead if the latter is kept from descending. Occasionally, the crosshead sticks, say on a lump of ice, or in a "tight place" in the guides, and its downward motion is arrested momentarily. After the rope and bucket have passed downward some distance, the crosshead may come loose, and falling may strike the rope clamp with sufficient force to break the rope or attachment. Several safety crossheads have been successfully used, which effectively prevent this accident. A catch is provided which automatically grips the rope and locks the crosshead and rope together, except when the former is resting on the stop-locks at the foot of the guides, and the grip on the rope is released.

It is only in anthracite mines, where coal is hoisted from several levels, and in metal mines where ore is hoisted in cars, that landing fans or keeps are used, so that this class of accident is rare. The cause is carelessness on the part of the foot tenders, who neglect to withdraw the keeps when going from an upper to a lower level, or of the engineer, who forgets to which level he is lowering the cage. The remedy is a signal system that indicates on the hoisting engineer's depth indicator, by light or some other means, just which keeps are in or out, showing the engineer at all times how far he can lower the cage.

To sum up the entire situation, we can safely say that almost all of the accidents commonly occurring in shaft hoisting can be avoided by the installation of suitable safety devices, and that with few exceptions such safety devices have been developed and can be used without interfering with the actual operation of hoisting in mine shafts.

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## Sampling and Estimating Disseminated Copper Deposits

By Ira B. Joralemon, Warren, Ariz.

THE sampling of disseminated copper deposits has been described often but the method of combining assays to give the true shape and value of the orebody as it will be mined has received less attention. As the ore mined during five or ten years at several of the great disseminated properties has averaged materially lower in grade than the published estimates, the question of the sampling and estimating of these orebodies seems timely. In this paper, attention is given particularly to factors that may cause errors in the final estimate. Sampling of diamond-drill holes, churn-drill holes, and underground workings is briefly described in the first part of the paper. Then the method of combining assays to give the average grade and tonnage that will be mined is taken up in some detail. The necessity of study of the geology of the deposit and of probable costs is emphasized. Finally, the methods of calculating tonnages are outlined.

There are three main requisites for accurate diamond-drill sampling. First, the core should be removed and the hole cleaned out at the beginning of every sampling interval, usually 5 ft. Second, all sludge and core from every sampling interval should be saved. Third, core and sludge assays for every sampling interval should be combined in such proportion as to give the assay content of all material removed from the hole.

Churn drilling is somewhat less accurate, in most cases, than diamond drilling. Unless the hole is cased nearly to the bottom, the frequent passage up and down of the bit and bailer knocks off material from above the sample. If the values are in soft seams, the sample will be too high grade. Even if the ore minerals are disseminated through the rock, the sample will be affected by material from higher up in the hole.

The best sample from underground workings is made up of all the material removed after every round is shot.

Channel samples must be taken where existing underground workings must be sampled, or where it is not practicable to take a proportionate part of every round as it is mucked. The accuracy of this method depends on laying down a rigid system of sampling,

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and adhering to it. The location and direction of channels should be most carefully studied, and the same channel interval should be used throughout the orebody.

Grab samples from rounds shot in underground workings are almost always high, and should be used only as rough checks on the other methods of sampling.

The results of all sampling should be recorded on assay maps, usually on a scale of from 50 to 20 ft. to the inch. Entering the assay, instead of the number of sample, on the map simplifies the later work of combining assays and estimating.

The ideal method for determining the assay content of a disseminated orebody is to check at least every fifth drill hole by a raise or test pit 50 or 100 ft. high or deep. One-tenth of all material removed from each round shot in these workings should be taken as a bulk sample, and the walls should be carefully channeled. As a further check, drifts should be driven between several test pits or raises, and bulk channel samples taken in them. By this combination method, the value of the deposit is absolutely proved, and the results of future drilling, raising, or test pitting can be trusted without further checking.

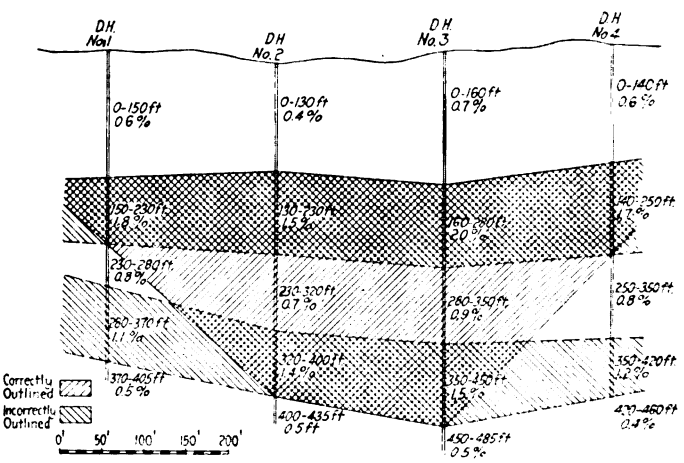
As an example of results of the three methods of sampling, in the development of the New Cornelia Copper Co., at Ajo, Ariz., over 1000 ft. of test pitting was done to check diamond drilling. The average of diamond-drill samples and of large channel samples checked to within 0.005 per cent. copper. The bulk samples, consisting of every tenth bucketful crushed and quartered mechanically, averaged 0.15 per cent. higher than the channel and drill samples. The drill and channel samples were accepted as correct. Several million tons of this ore have now been mined and treated. All of this ore to date has averaged 1.51 per cent. copper, compared with the estimate of 1.54 per cent. The grade has been a little higher than the estimate in one part of the orebody and lower in another part. This property has proved that, in a disseminated orebody it is possible to sample and estimate the ore correctly without reducing the grade by a factor of safety.

Before an estimate can be made that will check the mining, it is necessary to know what mining method will be used, and what the total cost of producing copper, and so the minimum grade of commercial ore, will be.

The tonnage, grade, and form of an orebody must be known in order to determine the mining system, costs, and minimum grade of ore that can be mined; and the mining system and minimum grade must be known in order to estimate the grade and tonnage of ore that will be mined. All the factors are interdependent.

The calculation of tonnage is a simple matter. Where the deposit is developed by drill holes on coördinates, the average depth of ore in holes on the four corners of every square, multiplied by the area of the square, gives a sufficiently close approximation to the volume of ore in the square block. The sum of the products of assay times depth of ore in the four holes divided by the sum of the depths of ore gives the average grade of ore in the block. If drill holes are not on coördinates, the deposit is usually divided into triangular vertical prisms, with a drill hole at every corner. The volume and grade of ore in every prism are found just as in the case of the square prisms described.

The sampling of a disseminated copper orebody is simple and should be very accurate. The estimation of tonnage and grade of ore in the deposit, once the length and grade of ore in every opening has been figured, is a simple mathematical problem. There is no excuse for great errors except where the irregularity of workings suggests the probability that richer portions of the orebody have been more thoroughly developed. The combination of individual assays in a drill hole or other opening to give the length and average grade of ore that will be mined is the difficult part of the problem of estimation. To solve it, the engineer must have an intimate knowledge of the geological occurrence of the ore, of the mining method to be used with its effect on recovery of tonnage and of copper, and of the total probable costs per ton of ore and per pound of copper, indicating the minimum grade of ore that will be treated at a profit. The failure to properly




VERTICAL SECTION THROUGH PART OF DISSEMINATED OREBODY SHOWING CORRECT AND INCORRECT OUTLINES OF ORE DEDUCED FROM DRILL HOLES.

study these factors is responsible for the fact that the ore mined in many disseminated copper properties has averaged from 0.1 to 0.4 per cent. copper lower than the estimates. This is an unnecessary error. The final estimate should check the tonnage mined almost exactly, and the grade of ore mined within less than 0.1 per cent. copper.

## Organization of Mine Sampling at Anaconda

By W. B. Daly and F. A. Linforth, Butte, Mont.

THE sampling and estimating of the orebodies in the mines of the Anaconda Copper Mining Co., at Butte, have been made a part of the work of the geologi-

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cal department. The wisdom of this assignment is apparent, considering the organization of that department, the nature of its records, and the scope of its regular work. In the first place, the district is divided into units of two or three mines each and a geologist is assigned to each group. His trips to all the working places are frequent and he follows the mining operations closely. His notes are graphic and detailed. In the office, he posts his notes on the standard maps and sections and on special maps for correlation purposes. With the approval of the chief or assistant chief geologist, he recommends development work underground and watches its progress. This gives the geological department a precise knowledge of the character of each orebody.

Sampling is done by one or two samplers at each mine, working under a chief sampler stationed in the geological office. The chief sampler has access to all the office maps and is in frequent consultation with the geologists; his instructions to the samplers are issued with the approval of the chief or assistant chief geologist. Not only is it important that the geologic information be used to direct the sampling, but the reports of the samplers and the records kept by their chief are useful to the geologist, who needs them in his work of estimating ore reserves and deciding on recommendations for development work. The sampler, moreover, is at the mine every day and makes a daily report, which keeps the geologist in close touch with the progress of development work. The sampler is attached to the mine office and thus comes under the jurisdiction of the operating department.

The ore deposits to be sampled are veins varying in width from a few inches to 50 or 60 ft. Steep dips predominate although dips at all angles are found. The veins belong to a complex system of fissuring of different ages and present a wide variety of vein filling. Some exposures present a hard mineralization of fairly uniform character from wall to wall, but many contain bands of altered granite, crushed in the process of faulting and carrying only scattered particles of metallic sulfides. A large part of the orebodies consist of veinlets of chalcocite or enargite traversing granite in such close succession as to make valuable ore of certain masses. Throughout the district, however, the structural features are fairly well defined and have served as a guide to the sampling.

The first step under the present organization was to classify all the probable occurrences to be sampled into a few standard types. Four types were found to be enough, to cover all exposures in the faces of drifts; they are: uniform ore; part good and part low grade; part good, part low grade, and part waste; narrow streak good but balance doubtful.

The sampler is required to examine each place to be sampled and decide to which type it belongs. He then takes the required number of samples, at breast height, along a horizontal line, irrespective of the dip of the vein. He also measures the width horizontally. This measurement is correct because the longitudinal sections upon which the ore blocks are laid out are projections on vertical planes. The ideal cut, or channel, across the face of the drift is impractical, from an operating point of view. Too much time would be lost if the miners had to wait while the sampler laid out and chiseled a neat groove across the vein; indeed, the varying degree of hardness of parts of the vein would make such procedure difficult. The same results are accomplished by the use of the sampler's pick. The sampler takes equal amounts of material from points along a predetermined line and catches it in a sack held open by a wire ring. Tests show that the accuracy of such sampling is sufficient for operating purposes.

For the estimating of ore reserves, there is a longitudinal section of each vein made to a scale of 1 in. = 100 ft. and projected on a vertical plane parallel to the strike of the vein. A certain minimum width and assay value is assigned by the operating department as the lower limit for ore. The drifts and raises on the long section are colored red wherever the assay curve shows the required grade of copper ore, and green for zinc. Waste drifts and raises are colored gray. This color scheme shows quite plainly what should be included in the ore reserve for each section. Blocks are laid out, therefore, upon the section and their volume and tonnage calculated in the usual way. For the grade of these blocks properly weighted, averages are calculated either from the curve records or from the more complete daily reports in the ledgers.

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## Sampling and Estimating Zinc and Lead Orebodies in Wisconsin

By W. F. Boericke, Chicago, Ill.

UNLIKE western vein deposits, the Wisconsin orebodies do not lie between regular walls, but form large, often highly irregular bodies, on a single floor in the so-called Galena limestone. The bottom of the ore is nearly always on a flat generally well-defined clay seam, a few inches thick, which marks the junction of the base of the Galena lime and the top of the next formation, the Trenton lime. Above the clay bed, the orebodies make the unique pitch and flat formation described by Chamberlain. Theoretically, we should find two pitches, one on either side of the top crevice, diverging as they go down, with the final flats a considerable distance apart on the clay bed. The area between, known locally as core ground, should thus constitute a single defined orebody, with the richer portions near the pitches and the leaner portion in the center of the core. Practically, we find few examples of this perfect orebody. Almost invariably one pitch is

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better defined than the other, and often the opposite pitch is marked only by a faint line of fracture showing stronger mineralization than the wall rock, or it may be totally lacking.

Late mining developments in the rich New Diggings field indicate that these pitches often assume a horseshoe or crescent shape, the richer ore being in the heart of the crescent, and the pitches showing less mineralization as they extend outwards. The length of the orebody may be several thousand feet, the height varying from 10 to 60 ft. and the width from 60 to 250 ft. In fact, on the core side, there is no definite end to the ore. The mineralization simply gets thinner and thinner, and the limit of working depends on the cost sheet and the profit from the recovery.

The mines are worked almost universally with underhand (breast) stoping, using a room-and-pillar method for carrying the ground. In most cases, a drift is is carried along the edge of the ore in advance of the stopes, and new stopes are opened up on the pitch as needed. These open stopes are frequently of great extent, sometimes 40 to 80 ft. high and 40 ft. wide between pillars.

Obviously it is impossible to sample such a stope by the usual methods, on account of the rapid changes in the richness of the pitches. Long practice and experience in the field, however, enable the mine operators to make surprisingly good estimates of their ground and the probable mill recovery, from visual examination alone; and by drawing proper amounts of dirt from the different stopes, a generally consistent mill feed is obtained.

Mill recovery, in itself, gives only an approximate idea of the ore in the ground. With free milling ores, the recovery may be good, and with chatty ores the recovery may be poor, from ground showing originally the same mineral content. Yet in the absence of elaborate and costly sampling of the mill feed and tailings, slimes, and overflow waters, the mill recovery serves as a rule of thumb to determine the mineral content of the ground, and is so regarded by the operators. I do not know of a case where an effort was made to sample the ground by underground methods alone. Reliance is always placed on visual examination of the ore faces, supplemented by known mill recoveries.

Churn-drill holes, spotted in advance of the heading or stope, give the most reliable method of sampling or estimating these orebodies. This is an expensive way to get the information and is only used when it is necessary to drill out additional ore, or to prospect with the idea of acquiring new leases or new ground for mining. In most cases the drilling precedes the actual development and mining of the orebody, so that from a careful record and study of the drill logs, a tolerably good idea is gained of the mineral content of the ground, the height of stopes, direction and dip of pitches, character of the back, etc.

When it is determined to drill ahead of an existing stope, a drill is spotted according to a careful survey about 50 to 100 ft. ahead of the stope, along the general direction of the range. Knowing the respective elevation of the surface and the back of the stope, the drill man is instructed to cut runs down to 2 or 3 ft. when he reaches the depth where he should get the top of the ore. All sludgings, thereafter, are carefully sampled and saved for subsequent examination and assay by the drill engineer in charge of the work. The drilling is continued until the clay bed, or glass rock, the next formation, is reached, regardless of whether the ore continues down or not. The drill engineer makes a log of the hole, for office use, noting particularly the character of the ground, with any change of formation, the amount of zinc, lead, and marcasite (known locally as sulfur), the presence of open ground and crevices, the water level, and particularly whether the ore occurs as sheet, disseminated, or crevice ore and any other items of interest that may help to interpret the hole.

In brief, this is the ordinary procedure in estimating the orebodies in Wisconsin. In general, the results, as shown by subsequent mining and milling practice, have been reliable, but there are many cases of disappointment. This has been often due to the failure to recognize the character of the ore (that it is not free milling) or of the ground, especially in disseminated deposits. Either condition may give higher assays than will be shown in subsequent development. It pays to be reasonably conservative in reporting on drill holes, and invariably to disregard rich runs and assays if they do not indicate a consistent mineralization of the ground, as checked out by other holes. Beware of orebodies with "freak" drill holes.

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## Stope Cost Records and Mine Contracts of the Anaconda Copper Mining Co.

By C. L. Berrien, Butte, Mont.

BEFORE the present company was formed, in 1916, each group of mines comprising the old organizations made its detailed daily and monthly mine cost records along the lines used before the consolidation; that is, there was no attempt made to standardize and compare the stope costs of all mines. The general cost sheets for all mines, however, were standardized, and cumulative labor cost sheets were compiled in the general superintendent's office.

Probably 95 per cent. of the stopes were square-set worked by day's pay; there were some back-filling and shrinkage stopes. Many of the development places, such as shaft sinking, station cutting, drifting and raises had always been run by contract. These contracts were given, for no definite period, at so much per linear foot and were measured monthly, or when completed, the men being paid monthly. In some cases, fairness to the employee was not maintained. On the whole, there was no standardization. There were no stope contracts, because of the objections of

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the Western Federation of Miners to general contracting in the mines.

Early in 1916, W. B. Daly, then general superintendent, and the author, then assistant general superintendent, visited the southwest mining districts with the object of finding some improved method. On account of local conditions on the surface, as well as underground, the fact was kept in mind that no new method would be acceptable that would cause:

1. A settling of the surface or any underground workings or shafts then in use, or that would be used in the future.
2. A lowering of the grade of the ore.
3. A violation of the rules of the Safety First department.

The result of this trip was the adoption of the following methods:

1. The cut and fill, or rill system, in all veins where the ore and walls are fairly hard, whether the ore must be sorted or not.
2. The timbered rill, where the ore and walls are not hard, whether the ore must be sorted or not.
3. The use of chutes every fifth set in square-set stopes and the more general use of slides to chutes.
4. The keeping of daily cumulative detailed costs for each stope that the foreman may check the efficiency of his men.
5. The employment at each mine of men having a thorough knowledge of underground mining and accounting to maintain a system of detailed costs.

## Record Forms

In connection with these new methods, it was our desire to provide for obtaining, recording and using the following information:

1. The comparative efficiency of different stoping methods.
2. The comparative cost of labor by different stoping methods.
3. The comparative cost of supplies by different stoping methods.
4. Total saving by new methods over old.
5. Efficiency, labor and supply costs of each stope in each mine and the separate details of these costs.
6. Periodical cumulative costs of all stopes.
7. A record of all mines stope costs for each foreman and superintendent.

Each mine, at the end of the month, has a completed stope cost record, which is sent to the office of the general superintendent, where the general stope cost record for all mines is made up. This sheet is almost a duplication of the mine stope cost record. It is made on tracing cloth, blue printed, and sent to each foreman and assistant superintendent. Powder, caps, and fuse are combined under explosives and net savings of the other methods over square-set stoping are shown. This system, and the methods of obtaining the information, have been used five years and have required no changes.

The custom of contracting on sills, in shafts, raises, and stations still is carried on; repair work, stoping, tramming and all other work had always been by day's pay. Stope contracting, though, was not practiced until April, 1919. This system was gradually installed until, by July 1, 1919, it was an actual working success in all stopes at all mines. Work in all stopes, raises, drifts, crosscuts, shafts and winzes is now done by contract on a cubic foot basis, the price per cubic foot being regulated according to conditions, such as the hardness of the ore or waste, the width of the ore, the method of stoping, accessibility, temperature, and humidity.

## Benefits of Contracts

The contracts are made for one week, at a set price, but may be terminated after one day by either the foreman or the contractors. The men are notified of the price on Thursday morning, which is the beginning of each contract week. No change in the rate per foot is permitted during the life of the contract, but adjustments are made in special cases, which must be noted by both the engineer and the foreman. The general benefits derived are:

1. The cost per ton of ore is less by contract. The men who are willing to work are given some individuality and the conservative men are inclined to break away from the I.W.W. theory of doing as little as possible in order to get by.
2. The stope cost record and contract system have given a more accurate check on the cost of underground operations than any method we have used.
3. By subtracting the ore tally from the engineers' contract measurements, a direct check on waste broken or tons of rock broken to obtain a ton of ore in each stope is obtained.
4. Measurement is allowed between the walls only, except where the wall is removed for timber. It is, therefore, to the best interests of the men not to break the walls, and the ore is kept cleaner and the average grade increased.
5. By taking the difference between the total labor cost of a stope on the stope cost record and the total contract money, the direct percentage of contracting in each stope or at each mine is obtained. Over 90 per cent. of the stope shifts are contract shifts. Any comparative cost data desired may be obtained directly from these records.
6. The contract system tends to keep the foremen and all bosses in closer touch with the mine and creates better supervision. When contracts are given, the list is posted at the mine showing price per foot and, when finished, full information of the results is posted, showing: contract number, working place, price per foot, total shifts, total money, and rate earned. Every man at the mine is paid weekly, which accounts for a great part of the successful operation of contracts.

It is understood at all mines that any contractor is free to interview the foreman of the mine and, if a satisfactory adjustment of his complaint is not made, he may take his case to the company labor commissioner. The case is then brought to the general superintendent. During the period of general contracting from April, 1919, to date, over 60,000 contracts have been let, but only six have been brought to the general superintendent for adjustment. This record is sufficient evidence that the method is a proper one, and can only be attained by the most careful superintendence and absolute fairness to the employees.

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# Some Considerations Affecting Percentage of Extraction in Bituminous Coal Mines in America

By H. H. Stoek, Urbana, Ill.

A STUDY of American coal-mine practice shows two of its distinctive features to be: A greater number of accidents per thousand employees than in any of the other leading coal-producing countries; a much greater percentage of the coal is lost than is the case in any of the other leading coal-producing countries. Although our subject is mainly concerned with the second feature, any consideration of mining methods should include safety, efficiency, and economy.

If in defense of our wasteful mining the argument could be offered that it was necessary on account of safety, and that it is carried out with less loss of life than is the case in other countries, the plea for conservation of coal could not be so strongly urged; but when we are wasteful of both life and property, the subject merits more consideration than it has received.

Space will not permit a detailed discussion, but a study of the literature on better coal recovery and a field study of successful methods will confirm the following conclusions and suggestions:

1. In considering the applicability of a method of extraction all of the conditions must be considered. For instance, the concentration method of the H. C. Frick Coke Co. used in many parts of the Connellsville district, where the geological conditions are similar to those of Illinois in most respects, is carried on under operating conditions that are quite different from those that prevail in most of the Middle West coal fields. An essential consideration for high recovery is a mobile labor force, which premits concentration of miners, and a rapid removal of the coal is necessary for the most successful recovery by any concentration method.

2. While there is a similarity in the successful methods used for obtaining high percentages of recovery, no standard and universal method has been developed; there are, however, a number of methods that adapt the same general principles to a wide variation of local conditions.

3. The best results are obtained by companies that mine under a definite projection plan for the future and are not dependent on immediate financial returns. The best result will undoubtedly be obtained by driving entries to the boundries of the coal area and drawing the pillars full retreating. Very good results are being obtained by drawing pillars within panels by driving the panel entries to the limit of the panel, then beginning the rooms at the inbye end of the entry so that pillar drawing may begin as soon as the inbye room is finished.

4. The successful methods for obtaining a high recovery get most of the coal from the pillars and not from the rooms, as in ordinary room-and-pillar work. The development of the present practice has been by a gradual widening of the pillars sometimes accompanied by a decrease in room width, but not always. Where best results are now being obtained rooms from 12 to 20 ft. wide are driven upon 90 to 100-ft. centers, thus leaving a pillar from 80 to 88 ft. wide. The width of room seems to depend more on whether or not yardage must be paid rather than on the nature of the roof.

5. For successful pillar work, strain on the roof above the rooms must not be great enough to cause the roof to fall before the pillar coal is removed or to make the cost of timbering such a roof prohibitive. The fall of roof in the rooms may be overcome by making narrow rooms, but the very narrow rooms used in some districts do not seem to be necessary.

6. A fundamental principle in pillar work, to prevent squeezing the coal back of the working face, is to take out as nearly as possible all of the coal so as to secure a roof fall as near as possible to the face of the pillar. Great care is taken not to leave stumps of coal in the gob, even though the coal recovered may not pay for the work of removing the stump, or may have to be abandoned in the gob, as they retard roof breaks.

7. It has been found wise, generally, to protect the men driving through pillars by a narrow curtain pillar between the working place and the fallen gob, this curtain pillar being removed in great part as the track is taken up in the working place.

8. Subsidence of the surface should be considered a probable accompaniment of pillar drawing and the pillars should be removed systematically so that the resulting subsidence may occur uniformly and not in isolated spots, for, although there may be a temporary disturbance of the surface with systematic pillar drawing, the surface conditions after a short time may be as good as or nearly as good as before the pillar drawing.

9. If the mine is at all gaseous, permissible explosives and electric safety lamps only should be used in the pillar work, as the men necessarily work near the old gobs where falls are constantly occurring.

10. Although statistics are not available regarding the relative numbers of accidents in pillar drawing and room work, a number of inspectors connected with liability-insurance companies and operating officials have expressed the opinion that there are no more accidents in pillar work than in ordinary room-and-entry work and that, while such work requires careful workmen, often they are not unusually skilled.

11. Pillar coal does not necessarily mean more fine coal, as is generally assumed, although care must be taken to prevent the making of fines. The increased use of fine coal will remove one of the great obstacles to pillar drawing; *viz.*, the fear that the percentage of slack will be increased.

12. The interpretation of the mine law in West Virginia regarding the spacing of crosscuts as meaning 80 ft. apart between openings on opposite sides of the room and not on the same side, as the laws are commonly interpreted in other states, has permitted

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a staggering of crosscuts and locating them 160 ft. apart on each side, thus giving a better condition for pillar drawing.

13. It was formerly considered that pillar coal must be hand mined but in recent years, particularly with the large pillars now used in many regions, the use of machines has proved practicable.

14. Undoubtedly one of the great drawbacks to more extensive experimentation in pillar drawing has been the fear of the operator in union districts that any improvement may mean a lengthy controversy, possibly a strike, and most surely a demand for an increase in the mining rate which may make a prohibitive differential against the proposed method.

15. It has been suggested that the government might set up a regulation requiring certain methods to be used that would give a maximum production under existing conditions, but this has not been tried and most likely it will not be except possibly in connection with some of the federal leases in western lands.

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## Mining Methods at the Ashio Copper Mine

By Masayuki Otagawa, Tokyo, Japan

THE mining methods adopted in Japanese mines are less known to the mining world than those of other countries, owing to the geographical remoteness, but they present many features of interest to mining engineers.

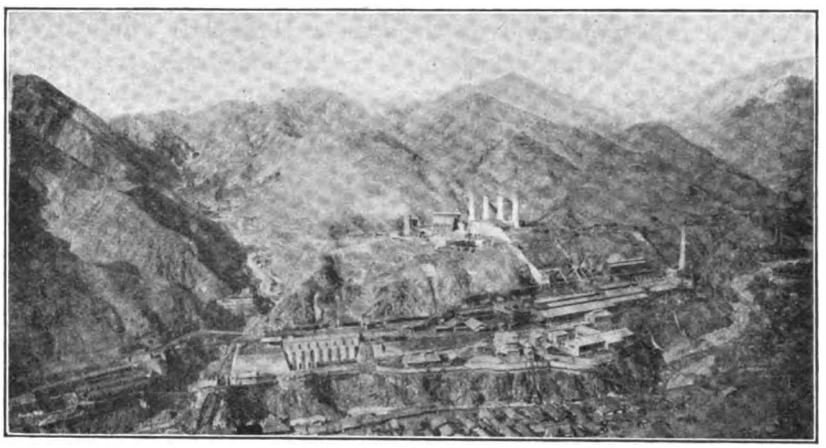
The Ashio copper mine is at the village of Ashio, in Tochigiken, about 109 mi. from Tokyo by railroad. The area of the concession owned by the Furukawa Mining Co. is 5000 acres. The mine was formerly divided into three, *viz.*, Honzan, Kotaki, and Tsudo, which are distant 3 mi. from each other. In 1914, when the writer was general manager, the three mining plants were amalgamated into one with the result of simplifying the working projects and increasing the operating efficiency.

The mine was visited by the Institute party in November, 1911.

Since the discovery of the enormous masses, called "Kajika" or "Bullhead" deposits, described by the writer in Mining and Metallurgy of December, 1920, the mining methods have been varied to meet the different conditions presented by these deposits.

The country rock of this mine consists of slate and quartzite into which has been intruded a plagioliparite neck more than 2 mi. in diameter, in the shape of an inverted cone which narrows downward to a relatively small diameter in depth. Nearly all of the deposits are veins, and they occur for the most part in the liparite, although a few are found in the sedimentaries.

The mine is developed by adit levels and blind shafts and is at present being worked to the depth of 3500 ft. below the surface. The daily output is 1000 tons o



General view of Ashio Smelter.

copper ore, mined from veins and kajikas in nearly equal amount.

Overhand stoping is employed in the veins. Each stope is 6 ft. high, 10 to 15 ft. long and more than 2½ ft. wide, depending on the thickness of the vein. The system of mining the kajikas is mostly by open, stepped-face, square sets. Development drifts are in either wall of the deposit with raises to the level above, and the sill floor is breasted out from the drift to each wall. The room is supported by round square-set timbering, 6 ft. square, center to center, both cap-wise and girt-wise and 6 ft. high. The sill floors are 7 ft. high. The diameter of the timbers for post, cap, and girt is 10 in.; on the main sill, 12 in. Since the ground is firm enough, the sets alone are relied upon to support the walls without filling. The ore is drawn off through inclined chutes into cars on each level and trammed to the shaft station. In most cases, cages are used in the shafts, but a skip with 2.5 tons capacity is installed in the Yokomabu shaft No. 2, which has a depth of 1080 ft. Kajika deposits are too wide for stulls, and the ground is fairly strong, but requires prompt support to prevent slabs falling from the back and walls; so this method of mining is justified by the lower cost of exploitation.

Although there are still many mines worked by the square-set system in the United States, in spite of the growing preference for shrinkage, filling and caving systems, there are few mines in Japan where the conditions are suited to the square-set method.

The Ashio mine was the first one where machine drills were extensively employed in Japan. Among them, Leyner Ingersoll, Ingersoll stoper, Jackhamer, and Ashio drills are chiefly used at present, the latter being designed and manufactured by the engineers of the mine. Its construction is much like that of the Jackhamer, having a butterfly valve, but it is much simpler and weighs only one quarter as much.

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# Can Anthracite Mines be Operated Profitably on More than One Shift?

By Dever C. Ashmead, Kingston, Pa.

FROM time to time metal-mine engineers have inquired why anthracite mines and their preparators are rarely operated on the two or three-shift basis. The subject may be approached as affecting: labor, development, the underground workers, the preparator, the outside workers, capital, the supply account, power consumption, the storage of coal over various shifts, railroad car supply, and the market.

From the start, the adoption of a plan of three full-shift operations in a day would cause difficulty with the colliery employees, for they have never worked on that plan and would show their resentment by suspending work. Even if they could be induced to work according to this schedule they would not be as efficient.

Operation on a three-shift basis would necessitate triple manning of each working place, and dissensions would arise betwen the men, for each shift would claim that the preceding shift had taken undue advantage and had not left as favorable conditions as they had found. To obviate these disputes it might be necessary to let out the work to a contractor, who would hire his helpers to mine out the chamber, or breast. The state mining law requires that a miner be put in charge of each working place. To conform with this provision he would have to hire three helpers and two miners to mine the breast. The labor unions have been trying to abolish the subcontractor in mine work and any method of working that would cause his return, however innocent in purpose, would result in labor disturbances.

It might be possible to form partnerships of three miners working a place together, but the men would probably have frequent dissensions as to the proportion of work performed by each shift. Only one other method of working remains—operation by company men—but this is ordinarily too expensive to be considered.

In addition, the state mining law requires that before he can become a miner a man shall have two years' experience and then pass an examination. This limits the number of miners available, and if all of the anthracite collieries were to go on a three-shift basis there would not be enough men to fill the working places.

The development work in those parts of the mine in which there is first mining is often on the three-shift basis. It is only with difficulty that this development work is kept sufficiently far in advance of the coal-mining forces to keep them supplied with working faces.

Ordinarily, with three shifts a somewhat greater number of foremen would have to be engaged. Where, of course, there is but one opening the number of foremen must be increased for there must be one man in charge of each shift; but where there is more than one opening there is usually a foreman for each.

If the mine were placed on three shifts, the number of men would have to be increased somewhat, for men would have to work on the ventilation in every shift, so that promptness in making repairs would be assured. More door boys would be required.

It is, however, in the solution of the transportation problems incident to the triple shift that the biggest difficulty would be encountered. The three-shift operation might well involve an increase of 150 per cent. in the transportation force without any compensation derivable from larger tonnage. The trouble today is that sections of the transportation system cannot be worked to capacity, therefore any dilution of the traffic by the introduction of the three-shift system would merely intensify a condition that even now is sufficiently crippling.

In those mines where silting is practiced, the three-shift plan would make it necessary to silt on all three shifts, provided that the preparation equipment as well as the mine was run with equal continuity. This would mean increasing the force almost 200 per cent. and yet obtain only the same output and do the same amount of silting.

In order to show the effect of the output on the number of men employed, nineteen curves have been compiled from data from ninety collieries having an annual output of 44,205,896 tons. The data from each colliery are plotted separately and an average made for each 50,000 tons increase; these points are indicated by a circle. The curves give due weight to these sub-averages, considering the number of observations involved in each. The high or low points apparently neglected are usually from meager, often single, observations or from known abnormal conditions. The curves are intended to represent general conditions, not individual cases.

The conditions under which triple shifting might be arranged have been tabulated, noting in each case the results favorable or unfavorable, deviating from the time honored plan of single shifting mine and preparator.

*Assumption* 1.—A mine of normal production operating under present methods.

*Assumption* 2.—An old mine with the preparator in good condition and operated with first and second mining; it is desired to place the mine on full three-shift operation to triple the output.

*Assumption* 3.—An old mine that can be operated by dividing the present force into three parts, each part working an integral portion of the mine, and operating the preparator on a three-shift basis. (*a*) By working different beds in different shifts; (*b*) by working different shafts, slopes, or drifts in different shifts.

*Assumption* 4.—The whole mine worked on a one-shift basis and the preparator on a three-shift basis.

*Assumption* 5.—A new mine, a preparator to be so planned as to operate on three shifts.

*Assumption* 6.—A new mine to be laid out to operate on three shifts and the preparator on one shift. (*a*) The output to be the same as operating under

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present methods; (*b*) the output to the maximum for each shift.

*Assumption* 7.—A new mine to be designed to operate on one shift and a new preparator on three shifts.

*Assumption* 8.—A consolidation of two or three collieries each to be operated on a separate shift, and the preparator to be operated on a three-shift basis.

*Assumption* 9.—A consolidation of two or three collieries each to be operated on three shifts and the preparator on a single shift.

*Assumption* 10.—A consolidation of two or three collieries, all to be operated on the same shift and the preparator on three shifts.

*Assumption* 11.—Two of three collieries to be abandoned and work to be concentrated in one colliery producing the same tonnage as obtained from the three; both colliery and preparator to be operated on three shifts.

The ten main conditions that must be considered in the multiple shifting of anthracite collieries are shown above and in Table 4; besides these others might arise in the case of any particular colliery.

There may be individual cases where multiple shifting of anthracite mines might be advisable due to peculiar conditions that are not general throughout the fields. It might be advisable, in case of accident to one operation, to give employment and maintain output, or if for any cause there is a serious shortage of coal, or on account of the pending expiration of a lease on a property. Such an operation would not be multiple shifted for any saving in operating expenses or continous use of capital but on account of special conditions.

Double shifting instead of triple has not been mentioned but the conditions and the items affecting this would be similar but less in degree.

From a study of the preceding, the effect of the different assumptions on the operation is shown and it appears that not one of the assumptions shows as economical and practicable a method of operation as the usual—a mine that operates on one shift and preparator of which also operates on the same shift.

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## Non-metallic Mineral-filler Industry

By W. M. Weigel, Tuscaloosa, Ala.

IN THIS paper, and generally in the trade, the term *mineral filler* is applied to a mineral used in its natural state after mechanical preparation only (such as grinding, milling and washing), without undergoing any chemical change and without exerting any chemical action on the substance with which it is incorporated.

The consumption of mineral fillers is confined chiefly to large manufacturing centers in the eastern and northern states.

The common mineral fillers are white clay, barite, mica, talc, whiting, ocher, silica, graphite and slate. The methods of mining and preparation, which are quite different, are discussed separately.

Sedimentary or transported white clays are the only clays used to any extent as fillers; the residual white clays, or kaolins, go to the ceramic industry. The principal centers of the clay-mining industry in the southern district are in the vicinity of Langley, S. C., and in the central part of western Georgia. Clay is used as a filler in the manufacture of paper, rubber, oilcloth, paint and, to some extent, in phonograph records, polishes, textiles, matches, and soap.

Barite is produced in Georgia, Tennessee, North Carolina, and Alabama; Georgia ranking first and Tennessee second in production. Deposits of sufficient concentration to justify mining consist of fragments of all sizes from sand to pieces weighing several hundred pounds, mixed with clay, pieces of rotten limestone, and sometimes quartzite. Barite as a filler is used in paper putty, textiles, and phonograph records, but mostly in the paint and rubber industries. For paint and paper, fine grinding and pure white color are demanded.

Graphite occurs chiefly in Clay, Coosa, and Chilton Counties, Ala.; this state which, since 1915, has produced over 60 per cent. of the domestic graphite, has been the subject of numerous papers and reports. The uses of graphite as a filler are rather limited, largely because of its flaky structure, its color, its electrical conductivity, the difficulty of grinding it to a fine powder and of obtaining a product free from grit. The highest grade graphite, free from grit, is used as a filler in lubricants; the lower grades, containing 60 to 75 per cent. carbon, are used in paint, stove polish, and foundry facings.

Mica, due to its characteristic structure, is a valuable filler in some lines of manufacture. North Carolina is the largest producer, but considerable mining is also done in Georgia and Alabama. Wet-ground mica is used largely in the manufacture of wallpaper, as a dressing or dusting powder for high grade rubber goods, such as casings and tubes, and in the compounding of rubber. This is one of the highest priced fillers. The superiority of water-ground mica is said to be due to its better luster, its ability to stay longer in suspension in water, and its lightness or low apparent specific gravity. Dry-ground mica is used as a coating on ready roofing, in some lubricants, phonograph records, ornamental paints, dusting or dressing powder for rubber, pressed, and molded goods and artificial stone.

The talc industry of the south is most extensive in southwestern North Carolina and northwestern Georgia. Ground talc is used as a filler in paper, paint, textiles, shoe polish, toilet powder, soap, artificial stone and to some extent in rubber, oilcloth and other articles. It is used largely as a dressing or dusting powder for rubber and roofing, leather, cordage and other lines of manufactured goods; the cheaper off-color grades are used as

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foundry facing, alone or mixed with graphite. Paint and paper require white talc; for toilet powder only the extra white is used, very little of which is produced in the south.

Whiting, the common name for finely ground marble or limestone, is one of the most widely used fillers. True whiting is ground chalk; other ground calcareous materials are substitutes. Production is now confined to Georgia, Tennessee, and North Carolina. Both dry- and the wet-ground are used in rubber, paint, a few grades of paper, linoleum, oilcloth, shoe polish, putty, tooth powder, roofing, artificial stone and asphalt paving.

Most of the southern ocher is produced near Cartersville, in northwestern Georgia, though promising undeveloped deposits occur in other states. Considerable amounts of red oxide of iron are produced, but this is generally used for its color and not as an inert filler. Domestic ocher is used largely as a filler in linoleum and to some extent in paint. While its color falls below the standard of some of the French varieties, recent tests indicate that the oil absorption of Georgia ocher is somewhat lower. It is used to a limited extent as a filler in some grades of rubber and paper.

Silica that may be used as a filler occurs as diatomaceous earth, quartz, and tripoli. Diatomaceous earth has been mined in Florida. Tripoli, which has resulted from the weathering of chert or siliceous limestones, has commonly been produced in preference to quartz as a silica filler on account of the ease of grinding. Silica as a fine-grained filler is used in paint and wood filler, in metal polishes, nearly all scouring soaps and cleansing powders, and to some extent in phonograph records and rubber.

Ground slate, or slate flour, is a comparatively new filler material. As a rule, it is ground from the scrap resulting from quarrying and working slate used for other purposes. Recently, however, the increased use of slate-surfaced roofing and shingles has created a demand for crushed slate, or so-called granules, that has been met by operating slate quarries especially for this purpose. Deposits of slate that are worthless as roofing slates or other products requiring sound material are suitable for granules if the color satisfies the roofers' demands. Red and green slates are used most widely, though dark gray is used to some extent. Slate granules are now produced in Georgia and Tennessee.

The technology of mineral fillers is for the most part an undeveloped field. Few of the filler producers have carried on any research work with a view to improving the grade of their products or adapting them to wider uses. The larger consumers have recently begun to realize the importance of careful laboratory tests of fillers, for such tests indicate why certain fillers are best suited to their needs. It is safe to say that no two consumers, even in the same lines of manufacture, have the same specifications for their fillers. Study, experimentation, and publicity will result in a better knowledge of the physical properties of fillers and will point the way to their more scientific preparation and use.

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## Effect of Quality of Steel on Case-carburizing Results

By H. W. McQuaid and E. W. Ehn, Canton, Ohio

IT IS usually assumed that chemical specifications are sufficient for steel to be used for case carburizing and if the steel analyzes within the ordinary limits specified for steel for this purpose, no difficulty traceable to the steel used should be encountered in obtaining satisfactory results in the case carburizing and hardening. Much work has been done to determine the effect of various alloying elements on the rate of carbon penetration, etc. but, little has been published in regard to the effect of the quality of the steel on the final results in the hardening of case-carburized steel parts.

The writers believe that the structure of the case both before and after quenching is greatly affected by the actual condition of the steel itself as made, and that for good results in the case-carburizing and hardening departments, the steel should be of the best possible quality as regards non-metallic impurities.

It is the purpose of this paper to prove that the presence of excess dissolved oxides in the steel, as made in the melting furnace, affects permanently the results obtained in carburizing and hardening and that it is possible that the presence of dissolved oxide can result in total unfitness of low-carbon steel for case-hardening purposes.

In the work discussed, in spite of the most careful inspection, trouble would occasionally develop in the hardening of case-carburized material, and large quantities of material would be rejected after hardening because soft spots were found by the file. This, it was noted, occurred in particular lots of work when nearly 100 per cent. of the pieces showed soft spots in the hard inspection test. The pieces, it was also noted, could be traced almost exclusively to certain heats of steel made in basic open-hearth furnaces.

When it was found that large quantities of certain sizes would not harden properly, the first step taken was to recarburize for a short time. This, in nearly every instance, failed to improve the result of the hardening. When it was found that the work that resisted all attempts to harden was confined to certain lots of basic open-hearth steel, checks were instituted to determine the cause of the difficulty.

Microscopic examination of many specimens of carburized work developed a striking difference between steels that would show soft areas after quenching and those that would be satisfactory. By a careful comparison of carburized steel from bars known to produce poor results with steel that gave good results, it

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became possible to determine, after carburizing, whether or not the pieces would have soft areas after quenching. It also became evident that, for some reason, a characteristic structure in the hypereutectoid zone was formed after carburizing in the steel giving trouble, which made it almost impossible to retain the normal martensite after quenching.

Microscopically, it became a simple matter to detect steel, after carburizing, that would not form normal martensite after the quenching, the difference between it and the normal steels being easily distinguished by the experienced observer.

It was found that the results to be obtained in carburizing and hardening varied with different heats of steel as made. This seemed to offer a means of checking and eliminating this class of steel as a steel of carburizing quality, because it was only necessary to carburize a section of a small test ingot poured from the ladle. This test was finally adopted after carefully checking. It was found that if this small test ingot, poured from the middle of the heat, was unsatisfactory, apparently the whole heat was unsatisfactory.

In order to determine the fundamental cause of the condition that affected the carburizing results, many experiments were made. The fact that in an otherwise normal steel, a ghost line through the case after carburizing would cause the pearlite to break down, with a very abnormal structure at this point, would indicate that the segregation of sonims in the ghost lines was a contributing cause.

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## Electrolytic Deposition of Iron for Building up Worn or Undersized Parts

By David R. Kellogg, East Pittsburgh, Pa.

THE electrodeposition of iron has been practiced for many years. During the war, the British army repair shops developed a method for building up worn parts of automotive machinery, aero engines, etc., using the cold sulfate bath and low-current density method. The method has been used successfully in commercial work for the production of about 6000 repaired parts. Experiments along the same lines have since been made at the Westinghouse research laboratory.

As a result of preliminary work, the procedure recommended by Thomas was adopted. After the piece had been cleaned with gasoline or benzine, it was made the cathode in an alkaline bath containing about 5 per cent. commercial lye and about the same amount of sodium carbonate, the exact amount being immaterial. A current density of 3 to 5 amp. per sq. in. was used. The piece was treated in this bath for 3 min., then it was washed in running city water and made the anode with approximately the same current density in 20 to 30 per cent. commercial sulfuric acid for an equal length of time.

This process gave smooth, tough, adherent coats which, when deposited on a carefully ground rod 0.485 in. in diameter and then ground to a thickness of 0.001 in. could be pressed through a hole in 1-in. cold-rolled steel 0.0005 in. smaller than the finished size of the rod, and then pressed back again with no signs of stripping.

A motor shaft having bearings $\frac{5}{8}$ in. in diameter by $1\frac{1}{2}$ in. long was purposely finished 0.002 in. small in diameter, plated oversize, reground to proper dimensions, and then assembled and run in bronze bearings for 1000 hr. with a load of 50 lb. per sq. in. projected area, using a short stiff belt with a clipper joint in order to give a pounding effect as well as friction. At the end of the run it was found that the wear was 0.0002 in., which is just a trifle less than the original material shows in factory-life tests. Plug and thread gages have been repaired by this means and have given good satisfaction although they are not as hard as heat-treated tool steel.

Some work of N. B. Pilling, as yet unpublished, has shown that the brittleness due to occluded hydrogen may be completely removed by heating for $\frac{1}{2}$ hr. at 300° to 400° C.

When cast iron is put through the electrolytic cleaning process, it emerges from the acid with a coating of graphite. It was thought that it would be useless to attempt to plate anything so covered with slime, but a cast-iron rod cleaned in the usual manner, covered with graphite and placed in the plating bath, was coated with entire success. Carefully ground test rods of cast iron were plated with a coating which, after grinding to 0.376 in., left 0.001 in. of coating and others were left after grinding with 0.010 in. of coating on a side. These were pressed through a hole in 1-in. cold rolled steel that was 0.0005 in. smaller than the finished size of the test piece, then pressed back again, but showed no tendency to chip or strip off. While it is usually cheaper to scrap standard cast-iron parts accidentally machined undersize, there are many cases where replacement of special parts would mean making new patterns and then casting, in which case the time and expense saved would amply pay for the necessary work of reclamation.

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## Crystal Structure of Solid Solutions

By Edgar C. Bain, Cleveland, Ohio

IT SEEMS likely that one of the new avenues of approach to many metallographic problems is the study of crystal structure, or, more accurately, the atomic arrangement, by means of the X-ray spectrometer.

The crystal structure of some materials has been carefully worked out by the mineralogist, but his methods, in general, are unsuited to commercial metals and a method that yields even better information is at

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hand as the result of work on the diffraction of X-rays by Laue and the Bragge, and later by Hull, St. John, and others. It should be understood that the contour of free crystals, which is the subject of measurements by the crystallographer, is the result of the atomic structure and, in general, bears a simple and obvious relation to it. The use of the X-ray spectrometer has been described frequently.

### Essential Characteristics for Each Metal

All metals are normally crystalline. Crystallinity requires regularity in atomic spacing; hence, parallel planes of regular spacing can be passed in many ways through a crystal grain containing all the atom centers. The distances between such planes are the data recorded photographically by the X-ray spectrometer. These planes act as a three-dimensional grating for diffraction; the nature of the assortment of such interplanar distances found in a crystal determines its type. The ultimate measure of these plane spacings is merely the distance along a strip of photographic film where darkened lines appear exactly as they appear on a photograph of the spectrum of visible light, for instance. Of course, instead of having a constant grating and analyzing the wave length, we have a constant wave length and measure the grating.

The logical first step in applying such study to metals is the determination of the atomic arrangement or crystal structure for all the useful pure metals. Both the type and the dimensions of the space lattice for the atoms in metals are computed from the pattern of lines on the spectrogram. Hence, this photographic pattern is essentially characteristic for each metal. A number of such photographic films are shown. So far as is known, the pattern for any metal differs at least in dimensions from the pattern of any other material.

In eutectics studied by the author, there were cases of limited solubility in the solid. But the two patterns revealed on the film were substantially identical with the two pure-metal patterns. Thus, the tin-lead eutectic showed both the pattern of lead and the pattern of tin, while in fact there were no crystal-grains of pure lead present but a solid solution of a small amount of tin in lead. Silicon-aluminum eutectic showed exactly the same evidence, though aluminum dissolves over 1 per cent. of silicon. This led to the prediction that a solid solution has a crystal structure similar to the structure of the solvent.

### Summary

1. A solid solution forms by replacement of solvent atoms by solvent atoms. If the pure solute is of a different crystal type from the solvent, the parent lattice changes very little in dimensions. In such cases, a limit of solubility is reached and at this point a new lattice is formed which may be an intermediate or the lattice of the solute.

2. Intermediate lattices, based on weak compounds probably, are present in the complex series.

3. When two metals, alike in crystallographic type, form continuous solid solutions there may be a gradual change in lattice size from one pure metal to the other.

4. Other supposed continuous isomorphous series are actually composed, for some range, of two separate crystalline phases. Both forms are likely in the same grain.

5. Thermal treatment may shift the range of overlapping lattices toward one or the other pure metal. The effect is most noticeable if one of the pair of metals is allotrophic.

6. For some constitutions of perfectly annealed solutions, the location of the solute atoms is probably known.

7. No case was observed where solid solution occurs by new atoms filling in the interatomic spaces (if such spaces exist), and it is not predicted that such cases will be found.

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## Spectrum Analysis in an Industrial Laboratory

By W. H. Bassett and C. H. Davis, Waterbury, Conn.

THE ease and value of the application of spectrum analysis to industrial chemistry appears to be appreciated in few of the large works laboratories of this country. For eight years, this analysis has been of great value to the authors in both analytical and metallurgical work.

To the analyst the complete qualitative analysis of an unknown alloy, revealed by a spectrogram, is a sure basis for the planning of the most direct and rapid method of attack. As the determination of each element proceeds, the purity of precipitates may be checked as often as desired.

The spectrograph proves invaluable in the recognition of impurities, the separation of which would entail a lengthy and difficult procedure, or when the weight of an unknown is less than is necessary to complete the desired determinations. A few hundredths of a gram will usually suffice for spectrographic analysis.

In the separation of the rarer elements, the spectrograph will show, with precision, the point where each step has been successful. In zinc of certain classes, indium, gallium, and germanium have been isolated in this way; the presence of antimony in lake coppers has been proved; and bismuth has been detected in zinc and in alloys where the presence of a few thousandths of a per cent. would be harmful. An antimony precipitate in a delicate determination may contain a considerable proportion of tin or arsenic, both of which will be revealed. The spectrograph is consequently important to the metallurgist as well as to the analyst.

Impurities in raw material are often a source of annoyance, especially when their detection involves delay and costly analytical work. Whether low con-

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ductivity in copper is due to arsenic, nickel, or something else may be quickly found out. Residual traces of boron, magnesium, manganese, silicon, vanadium, and other deoxidizing agents are easily identified where wet analysis may fail to reveal their presence, even after days of effort. Complex alloys of any kind are dissociated by the spectrograph into a spectrum, the reading of which gives the elements present, together with an idea of the relative amounts of each. The secrets of the inventors of alloys and hardened metals are no great problems when, for their solution, one can depend on the application of the microscope and spectrograph.

In plates accompanying the full paper, several spectrograms are given showing the dispersion and quality of the lines and instances of the general usefulness of the large quartz spectrograph.

This article is the summary of a few instances where spectrum analysis has proved its value and is intended to show the ease, accuracy, and rapidity of accomplishment in one field only—that of metallurgy.

## Experiments with Sherardizing

By Leon McCulloch, East Pittsburgh, Pa.

WHEN clean iron and metallic zinc dust, protected from the air, are heated below the melting point of zinc, the iron takes on a coating that has excellent protective value. This coating is a brittle alloy of zinc and iron, and the process is called *sherardizing*. Although the zinc particles are covered with oxide and cannot touch the iron, an extremely small amount of the zinc vaporizes and the vapor, reaching the iron, alloys with it. Other zinc then vaporizes to replace that which has been removed from the atmosphere. This process continues indefinitely at a decreasing rate, for the coating already formed permits zinc to diffuse through it to combine with the iron beneath. In this way, the coating grows outward from the surface of the iron, as the bark grows from a tree.

The composition of sherardized coatings varies from the outer surface inward, as would be expected from the mode of growth. That is, the iron content increases slowly at first, then more rapidly as the iron is approached. At the surface the least amount of iron possible is 6 per cent. as the experiments described in this paper have shown.

A study was made of the effect of iron in zinc dust on the process and on the resulting coatings. From the curve between iron in the dusts and iron in the resulting alloys, certain conclusions can be drawn:

It is evident that no part of a sherardized coating can contain less than 6 per cent. iron, as heating even for 45 days fails to lower the amount at all. When the dust contains less than 6 per cent. iron, the resulting alloy contains 6 per cent. As the iron is increased from 6 to about 10 per cent. the composition of the alloy changes proportionally.

These results are in general accord with the well-known equilibrium diagram for the zinc-iron alloys. There is this material difference, however, these results show iron to be insoluble in zinc at temperatures below the melting point, while the diagram indicates a solid solution containing about 1 per cent. iron.

The iron content in a dust should be low, but there is some question as to what the limits should be. "Dross" dust containing iron is cheap and the percentage of iron increases with use, as zinc is removed while the iron remains. Iron in dust is useful as it raises the melting point and prevents fusing or caking when a high temperature is used to give rapid deposition. Iron, however, rapidly lowers the rate of deposition, making it necessary to employ higher temperatures.

The iron content should not exceed 7 per cent. An analysis of the dust should include the metallic iron. The important thing is the ratio of the metallic iron to the metallic zinc, rather than the percentage of iron to the total dust.

Life tests show that there is a minimum weight of zinc per square inch necessary for good coatings. To test the value of sherardizing, the weight of zinc should therefore be determined. There are various proposed methods for doing this. A new method depends on the fact that a boiling 10 per cent. solution of ammonium chloride removes zinc from sherardized coatings rapidly, but does not dissolve iron until the zinc is practically gone. This test may be applied in two ways: The coating is completely removed and its amount determined by loss in weight; or the weight of the coating is found approximately by noting the time for iron to appear in the boiling solution. At each 5-min. interval, a drop of the solution is removed upon a spot-plate and tested with potassium ferricyanide for the presence of iron. When the blue color appears, the coating is gone, and the time is a measure of the weight of zinc. A good coating should withstand this test for 10 or 15 minutes.

## Arsenical Bearing Metals

By Harold J. Roast and Charles F. Pascoe, Montreal, Que.

THE object of this investigation was to compare the arsenical antimony lead alloy with some of the regular bearing-metal alloys. With this end in view, the following tests were made:

1. Chemical analyses to show the composition.
2. Thermal analyses.
3. Macroscopic examination of fractures.
4. Microscopic examination.
5. Tensile tests.
6. Crushing tests.
7. Scleroscope tests.
8. Brinell tests, at temperatures from 80° to 400° F.

Tests 3 to 8 were conducted on both sand-cast and chill-cast specimens.

For the purposes of this paper the alloys have been numbered from 1 to 6; their composition is as follows:

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| Number | Lead, Per Cent. | Antimony, Per Cent. | Tin, Per Cent. | Copper, Per Cent. | Arsenic, Per Cent. |
|---|---|---|---|---|---|
| 1 | 82.64 | 12.95 | 4.40 | 0.01 | none |
| 2 | 27.54 | 9.94 | 59.87 | 2.65 | none |
| 3 | 77.65 | 20.75 | none | 0.13 | 1.47 |
| 4 | 82.95 | 16.85 | none | 0.20 | none |
| 5 | 83.78 | 15.35 | none | 0.05 | 0.82 |
| 6 | 0.15 | 7.87 | 84.13 | 7.85 | none |

The analysis, in the case of the antimony, was made by solution in sulfuric acid and titration with permanganate. For tin, the ferric-chloride method was used; for copper, the alkaline separations, and the thiocyanate methods; for arsenic, volatilization of arsenic and titration with iodine. The lead, with the exception of alloy, was taken by difference.

With the exception of No. 5, the alloys were taken as received from the manufacturer. About 40 lb. were melted in a graphite crucible and recast into small ingots to ensure uniformity of composition; samples for analysis were taken from these remelted ingots.

Of the six alloys taken for comparison, the high tin base is undoubtedly the hardest, the strongest, and the most resistant to crushing loads. On the other hand, all the alloys stand 1000 lb. per sq. in. without deforming, and all deform but slightly at 5000 lb.; in other words, none would be expected to squeeze out of a bearing at ordinary loads. Leaving out No. 6, the arsenical alloys maintain their hardness as the temperature rises better than the other alloys. Structurally, the arsenical alloys have by far the finest grain while having hard crystals embedded in a softer but tough matrix. The arsenical alloys can be poured at a lower temperature than No. 6 and run more readily at, say, 700° F. than any of the other alloys. Further, they show less sign of oxidation. In the matter of cost of components, the arsenical alloys (not taking into account the special cost of alloying in the case of the latter) will be less than the high tin alloys but more than alloys 1 and 4. All of these tests have been carried out from the practical rather than the academic point of view and several lines of experimental work are suggested.

## Studies on the Constitution of Binary Zinc-base Alloys

By W. M. Peirce, Palmerton, Pa.

THE present work has been done in an endeavor to correlate and complete the data on the constitution of alloys of zinc with other common metals, dealing exclusively, however, with the zinc-rich alloys in which the zinc content is between 90 and 100 per cent. This investigation has included the systems lead-zinc, cadmium-zinc, iron-zinc, copper-zinc, aluminium-zinc, nickel-zinc, manganese-zinc, cobalt-zinc, tin-zinc, and magnesium-zinc. The important ternary system zinc-lead-cadmium and the zinc corners of other ternary systems have been investigated in connection with this work but are not treated in this paper.

Zinc does not form a single homogeneous zinc-rich solid solution over any considerable range of concentration with any of the metals mentioned. A limited range of solid solubility is said, by previous investigators, to occur in several cases and certain effects on the properties of zinc are attributed (with varying degrees of consistency among different writers) to the presence of certain other metals dissolved in zinc. The increasing use of rolled zinc and the possibilities offered by zinc as a casting alloy in certain fields have made it essential to determine precisely these equilibrium relationships.

In carrying out this investigation, reliance was placed chiefly on two methods, conductivity measurements and microscopic analysis. The first method proved valuable in determining the existence and extent of solid solubility. The second method stands alone as a means of determining structural characteristics and supplements the first method in the measurement of solid solubility. No hardness curves are included in this paper, for in no case were they important in arriving at the constitution of any system.

It is impossible in a brief abstract to enumerate or describe the 51 diagrams illustrating the results of these valuable researches, all of which are given in detail.

## A Possible Origin of Oil

By Colin C. Rae, Denver, Colo.

THE absence of paraffin hydrocarbons in the soil, although they are concentrated in extensive deposits in some localities, the common distribution of plant remains through many formations that are not productive for oil, and many other factors, seem to indicate the existence of an intermediate organic compound between the complex plant compounds and the paraffin hydrocarbons; and much evidence points to the humus acids or associated organic compounds, which are probably collected by surface waters and concentrated in certain areas by means of precipitation by electrolytes, which would be contained in sea water or possibly in various inland seas or lakes.

There are many present-day evidences of the association of petroleum with humus acids. Many of the rivers carry much humus acid in solution, and some tropical rivers carry in the aggregate millions of tons of humus each year. The analyses of various river waters show a close relationship between the amount of organic matter and the amount of free uncombined silica. By chemically equating the positive ions to the negative ions in the various analyses of river waters, there is apparently an excess of free silica, most probably in a colloidal state, varying from a fraction of 1 per cent., in rivers with little organic content, to 44 per cent. in tropical rivers, such as the Uruguay.

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The relation between the silica and humus is not clearly understood and prominent chemists have given conflicting views concerning the physical and chemical relationship.

The combined silica is chiefly in the form of sodium metasilicate, which has been shown, by Kohlrausch and others, to be hydrolyzed in solution into colloidal silica and sodium hydroxide. Uncombined silica must be present as colloidal silica since silicic acid hydrolyzes, forming the colloidal solution. A colloidal suspension is finely divided solid matter in the presence of the solvent.

Another factor to be considered is the possible precipitation of organic compounds by sea or inland lake waters. Binney, Haseman, and others have called attention to the association of formation of petroleum or asphalt with humus conditions in the presence of sea water. Chemically, the coagulation of colloids is effected by electrolytes such as $Al_2(SO_4)_3$, $Fe_2(SO_4)_3$, $FeCl_3$ and other salts, when present in sufficient quantity. When sufficient electrolyte is added to the colloidal suspension, the colloidal particles attract the oppositely charged ions, and the difference in potential between the colloid particles and water decreases, increasing the surface tension. As a result, the colloid particles are drawn nearer together and are precipitated. Hence, the coagulation of organic matter, colloidal silica, and sulfur, can be effected by sea water, due to the presence of the needed electrolytes.

Experiments by prominent chemists have proved that the humus-acid groups, whose exact chemical composition is not well understood, can become colloids, and as colloids are easily precipitated by sodium chloride, calcium sulfate, and other salts. This fact probably explains the action of sea water in removing organic impurities from the river waters.

The gradual transformation of the organic hydrocarbons, precipitated by the electrolytes of the sea water, into the petroleum hydrocarbons could probably take place under several sets of conditions and would vary according to alkalinity, salts, and the presence of catalytic agents in associated formations, together with conditions of pressure and temperature. The evidence of action of sea water on waters of peat bogs seems to indicate that a slight amount of petroleum can be formed under proper conditions even where only normal conditions of pressure and temperature are present.

In the oil-shale beds of the west, intermediate organic compounds between the humus and paraffin hydrocarbons are apparently present, which require heat to change into petroleum. The character of the intermediate compound has been the subject of much discussion and comment, the prevailing idea being that the organic matter was chiefly carbonaceous and plant remains. However, microscopic studies of the shales have shown that while pieces of plants, pollen grains, seeds and spores are numerous in the shale with low oil content, the rich shales have virtually no plant or organic remains but apparently have some intermediate organic compound between the organic material and oil which may be changed to petroleum on application of heat and pressure.

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## Production Problems in the Grass Creek Oil Field

By Edward L. Estabrook, Casper, Wyo.

THIS paper gives a brief account of the geologic and production problems encountered in the Grass Creek oil field, the methods used in their solution, and the beneficial results obtained from the work.

The Grass Creek oil field is in Hot Springs County, Wyo. The productive area includes about 2½ mi. on the apex of a great anticlinal fold occupying more than 150 sq. mi. Oil was discovered in the field in June, 1914; development proceeded rapidly and production rose to a maximum in 1918. The marketed production has been approximately as follows:

| | Barrels | | Barrels |
|---|---|---|---|
| 1915 | 94,073.5 | 1918 | 2,946,774.27 |
| 1916 | 1,404,183.97 | 1919 | 2,000,584.84 |
| 1917 | 2,780,697.51 | 1920 | 1,485,080.94 |

About 350 wells, 800 to 1500 ft. deep, have been drilled to reach the upper oil sands; two companies, the Ohio Oil Co, and the Midwest Refining Co., operate the entire field.

The principal producing sands in the field are members of the Frontier Formation, a series of sands and shales occurring in the upper portion of the Colorado Group of the Upper Cretaceous Series. These Frontier, or "Wall Creek" sands are also productive in the Salt Creek, Big Muddy, and Elk Basin fields and, therefore, are much the most important reservoirs of light oil in Wyoming. At Grass Creek, the sands in the Formation are more numerous than in the other fields and much less uniform in thickness and character. Usually, eight distinct beds are encountered and in some wells twelve sands have been reported.

The upper, or First, sand in the Frontier Formation is reached at depths varying,from about 350 ft., in the center of the field, to 1000 ft. at the extreme edge. It ordinarily contains water in moderate amounts, but sometimes is so shaly and close-grained that very little water entered the well and it is reported in the logs as "dry." The Second, Third, Fourth, and Fifth sands produce gas in a small area at the apex of the dome and oil over the rest of the field. The Sixth, Seventh, and Eighth, sands are oil-bearing over the entire field. All of these sands contain water on the flanks of the anticline outside of the oil-producing area. The relative positions of the water lines (the oil-water contact) in the different sands have not been accurately determined, but the information available indicates no wide variation between them except in the Fifth sand.

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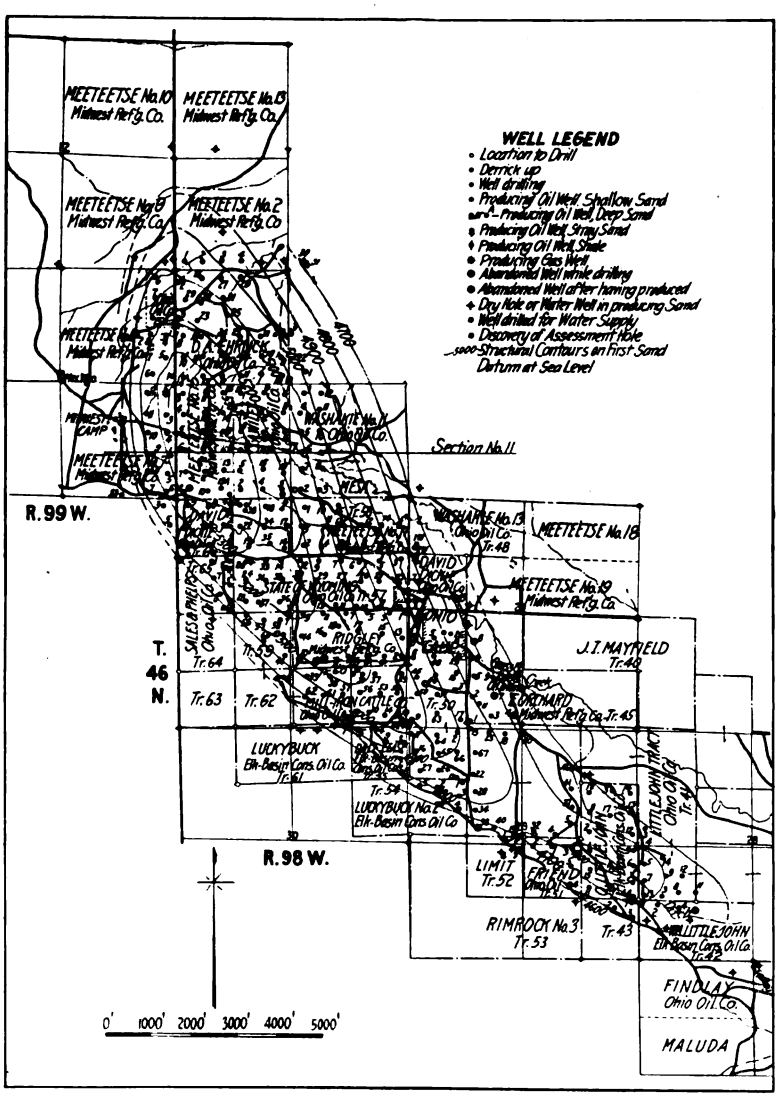
At the north end of the field, water is found in that sand at least 200 ft. structurally above the water line in the other sands. Some of the first producing wells encountered three oil sands and then found water in the Fifth sand, so a rule was formulated that wells should be stopped after reaching the third oil sand.

The application of this "three sand" rule is responsible for the confusion in identifying the different sands, and for many of the water troubles in the field. The difficulty arose through the fact that a well drilled in an area around the apex of the anticline encountered several small gas sands, after passing through the water sand, and then found three good oil sands; while a well ½ mi. out would, at about the same depth, have encountered a water sand and then three good oil sands. Drillers accustomed to the gentle dips of the Mid-Continent fields quite naturally considered that the three producing sands in each well were identical and they were accordingly named the First, Second and Third sands. The water and gas sands were thought to be strays. Actually, the water sand encountered in both wells was the First sand of the Frontier Formation, the gas sands of the first well were the oil sands of the second, and the oil sands of the first were not reached by the second well. The well on the crest of the anticline had penetrated the entire series of Frontier Sands, while the well on the flanks was only half way through them. Intermediate wells encountered the first oil sands progressively higher in the Formation and were stopped after reaching the third oil sand.

The fact that many of the wells did not penetrate all of the oil sands in the Frontier Formation was noted in a report on the field by D. F. Hewett in 1917, but his findings did not receive the attention they deserved. In the course of some work on a revised structure-contour map of the field, during the winter of 1919, the writer arrived independently at the same conclusion. A comparison of graphic logs made it evident that a large percentage of the wells would tap additional productive sands if deepened from 10 to 150 ft. Where the lowest sand in the Frontier Formation had been reached in wells on the crest of the anticline, it had been found to be the most productive member in the group; yet over the greater part of the field it had not been touched. The fact that the production of the field had fallen off rapidly during 1919 gave added importance to the possibility of obtaining oil in the lower sands.




GRASS CREEK OIL FIELD.

The correctness of the conclusion that there were pay sands that had not been reached by many of the wells was tested by drilling well No. 18 on the Ridgley lease in the southern half of the southeast quarter of section 19. This well was put down through all the sands of the Frontier Formation and each one tested for its content of oil and water. The First sand was found to be water-bearing as usual; the Second, which had been an oil sand when the surrounding wells were first drilled, was partly filled with water; the Third and Fourth sands, which had been yielding oil in offset wells for several years, were still light producers; the four lower sands, which had not been reached in the vicinity, gave an initial production of 90 bbl. in 24 hr. when pumped on the beam. Seven months later, nine wells out of the eighteen on this lease had been deepened and the production had increased 250 per cent. Similar results are being obtained on other leases in the field.

The problem of stopping the circulation of water from the First sand downward, and later through unprotected sands, appeared to be one of great difficulty if undue expense was to be avoided.

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**Regulations** under which electric motors designed for use in gaseous mines may be submitted by manufacturers for testing by the United States Bureau of Mines are contained in Schedule 2–B, which may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

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# Personal Notes and Biographies

**W. L. Cumings** sailed for Chile on Jan. 7.

**Charles A. Dobbel** is assayer with the Patterson Mining Co., Tuttletown, Cal.

**G. E. Alderson** is metallurgist with the Duquesne Reduction Co., Pittsburgh, Pa.

**B. E. Moir** has been field engineer with the Atlantic Oil Producing Co. since last November.

**Alexander V. Dye** is American Trade Commissioner at the American Embassy, London, England.

**F. B. Forbes,** Lieutenant, 24th Infantry, has been moved from Manila, P. I., to Columbus, N. M.

**Harold A. Steven** is manager for the Henderson Farmers Lime, Ltd., at Beachville, Ont., Canada.

**O. F. Ernster** is with the Companhia de Petroleo de Angola, Loanda, Angola, Portuguese West Africa.

**R. A. Bull,** consulting engineer, has moved his office from Sewickley, Pa., to 639 Diversey Parkway, Chicago, Ill.

**Dwight L. Sawyer** has left Salt Lake City for Matahambre, Cuba, where he will be geologist for Minas de Matahambre, S. A.

**J. M. Longyear, Jr.,** has gone from Marquette, Mich., to Jimenez, Chih., Mexico, to be superintendent of the Julieta gold mine.

**Magnus Poulsen** was appointed some time ago to the position of Directeur Général de la Société Belge Industrielle et Minière du Katanga.

**John J. Moisan,** mill superintendent of the Benguet Consolidated Mining Co., Benguet, P. I., has been made assistant superintendent for that company.

**W. P. Gage,** recently with the Lone Star Gas Co. in Dallas, Tex., has moved to Houston, to enter the employ of the Humphreys Pure Oil Pipe Line Co.

**E. F. Davis,** recently with the Matador Petroleum Co., at Cheyenne, Wyoming, is in the geological department of the Shell Co. of California, San Francisco.

**Edgar Kraus** is geologist with the Atlantic Oil Producing Co., making his headquarters in Houston, Tex., and continuing his work in the Gulf Coast district.

**Gardiner M. Boyd** has left the Thetford mines of the Consolidated Asbestos, Ltd., and is with the United States Ferro-Alloys Corpn. at Black Lake, Que., Canada.

**R. M. Macaulay,** mining engineer for the Consolidated Mining & Smelting Co. of Canada, who has been investigating the phosphate industry in the western states, has returned from San Francisco to his home in Rossland, B. C.

**William W. Elmer** and **George C. Hogg** have an office in the United States National Bank Bldg., Portland, Ore., for consulting work in mining and civil engineering.

**Henry B. Smith** has left the New Britain Machine Co., New Britain, Conn., to work with G. J. Comstock in the laboratory of the International Silver Co., at Meriden, Conn.

**John K. Walsh,** recently returned from South America, has accepted the position of professor of mining engineering at the Oklahoma School of Mines, Wilburton, Okla.

**J. R. Thoenen** is general manager of the Spar Mountain Mining Co., at Cave in Rock, Ill. He is also consulting mining engineer for the Peerless White Lime Co. of St. Genevieve, Mo.

**Hugh M. Henton** has resigned from the faculty of the Case School of Applied Science and has opened an office for consulting work in metallurgy and mining, in the National City Bldg., Cleveland, O.

**John K. Knox** spent most of 1921 studying the petroleum resources of Baluchistan. He is now making an expedition for the Whitehall Petroleum Corpn., into some of the less explored parts of Burma.

**J. B. McGraw** recently severed his connection with the General Briquetting Co. of New York, after five years service as fuel briquetting engineer, to become manager of the Anthracite Briquette Co. of Canada, Ltd., at Toronto, Ont.

**H. C. George,** with the Petroleum Division of the U. S. Bureau of Mines, recently completed a five-months trip through the California, Wyoming, Mid-Continental and eastern oil fields. Mr. George is making a study of surface equipment of pumping oil well properties.

**W. R. Ingalls** has written a treatise on the "Wealth and Income of the American People," which will be published by the G. H. Merlin Co. (York, Pa.) early in February. It is an economic survey of the consequences of the war and carries forward much of the thought that Mr. Ingalls has expressed in contributions to MINING AND METALLURGY and other periodicals. It is an elaborate essay into the field of quantitative economics. It inventories in great detail the wealth of the country in 1916 and in 1920, gives the national income over a series of years, computes the national living expenses and gives a balance sheet showing how we stand. It is, in short, a comprehensive analysis of our national finance and industrial affairs.

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## Edward Crawford Arnold

EDWARD CRAWFORD ARNOLD, general mine foreman for the Federal Lead Co., Flat River, Mo., died at his home in Farmington, Mo., on Dec. 7, 1921, after a brief illness. Mr. Arnold was born in Graham, Tex., Nov. 22, 1885, the son of Judge Robert F. and Catherine Arnold.

After completing the course at the Graham High School, he attended the A. and M. College of Texas from which he graduated in 1906 with the M. E. degree. He was instructor in the Manual Training High School, Marlin, Tex., for a year and engineer for the Wichita Falls and Southern Railway another year and then went to Inde, Dgo., Mexico, as shift boss at the cyanide plant of the Inde Gold Mining Co. In 1909 and 1910, he attended the University of Texas, at Austin, and specialized in mining; then returned to the Inde Gold Mining Co., holding the positions of mill shift boss and assayer until the fall of 1913, at which time he returned to the United States on account of troubled conditions in Mexico. He then accepted a position with the Federal Lead Co., at Flat River, Mo., where he held the positions of assistant engineer, assistant in experimental plant, chief engineer and general mine foreman.

Mr. Arnold had a remarkably even temper and a sunny disposition and was universally esteemed and admired by both his business and social associates.

He was married in 1915 to Miss Ethel Morris of Farmington, Mo., who survives him.

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## James Duane Ireland

JAMES DUANE IRELAND died on Dec. 6, 1921, at Cleveland, Ohio, after an illness of several months. He was 43 years old.

Mr. Ireland was graduated from Yale in 1900, and received degrees in Mining and Mechanical Engineering in 1902 and 1903 at the Massachusetts Institute of Technology. His activities in the mining field commenced immediately after this. He was employed at the Camp Bird mine in Colorado, then spent a few years prospecting in Arizona, Southern California and northern Mexico. In 1907 he became mining engineer for M. A. Hanna & Co. of Cleveland, Ohio, and took up his duties on the Mesaba and Michigan Ranges.

In 1908, Mr. Ireland was appointed general manager of the iron-ore properties of this company, and opened offices in the Sellwood Building, Duluth, Minn. He continued in this capacity until 1917, when he was made a member of the firm and left for Cleveland.

Under Mr. Ireland's managership, a number of original ideas were successfully developed, among which can be classed: (1) Drying iron ores before shipment from the mines, as a means of rendering commercial a number of ores, which on account of excessive moisture are not merchantable. The first plant for this purpose, an experimental one, was built in 1909 at the old Hollister mine near Crystal Falls, Mich., and was followed by large plants built at the Brunt mine near Mountain Iron, Minn., and at the Wakefield mine, Wakefield, Mich. (2) The first mill in the Lake Superior region using jigs for the concentration of banded ores. This mill was built in 1911 at the American mine, near Ishpeming, Mich. (3) The method of stripping on the Mesaba Range by means of a large revolving dragline machine, in such a way as to overcast the spoil from the first cut and then recast this material to make room for depositing the spoil from a second cut, all this being accomplished without the use of locomotives and dump cars. (4) The use of the first all electric shovel on the Mesaba Range. Mr. Ireland was among the first to recognize the advantages of using electrical apparatus at the iron-ore mines in the Lake Superior region, and to adopt a policy of complete electrification.

After Mr. Ireland moved to Cleveland, he was elected vice-president in charge of the operation of the Susquehanna Collieries Co., which constituted the company's holdings in the anthracite region. Under his direction a complete rehabilitation was undertaken, which involved electrification of 14 collieries, with the construction of three central-power stations, each having a capacity of 15,000 kw. and one of 2000 kw.; the sinking of new shafts, and building new breakers as a means of eliminating old and inefficient ones, and in some cases concentrating a number of collieries into one breaker with the same object in view. This work was started in 1918 and a large part had been completed at the time of his death.

He leaves a widow, Elizabeth Clark Ring Ireland, and one son, James Duane Ireland, Jr., eight years of age.

R. S. WALKER.

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## De Bernier Whitaker

DE BERNIER WHITAKER, vice-president and general manager of the Bethlehem-Cuba Iron Mines Co., died at Santiago de Cuba, Cuba, Dec. 25, 1921, at the age of 52.

Mr. Whitaker was educated at the University of North Carolina. He became connected with the Maryland Steel Co. of Baltimore and then went in 1898 to Santiago de Cuba as chemist for the Spanish-American Iron Co. Later he became general superintendent of the Juragua Iron Co., a subsidiary of Bethlehem Steel Co., and upon the purchase by Bethlehem of the properties of the Spanish-American Iron Co. he became vice-president and general manager of all their iron mines in Cuba.

Mr. Whitaker became a member of the A. I. M. E. in 1899. He was also a member of the Engineers Club, New York.

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## Strangman Hancock

STRANGMAN HANCOCK, who died on Oct. 29, 1921, at the age of 56 years, was the younger son of the late Thomas Strangman Hancock of Lisburn, Ireland. He followed the profession of mining engineering, first in North Carolina and later in South Africa, for 25 years.

He served in the South African war, first as captain in the Railway Pioneer Regiment, later in the Rand Rifles, and held the appointment of J. P. while in that country. He went to reside at Kennel Holt, Cranbrook, Kent, in 1909 and was appointed J. P. for the county in 1912. He was also a Commissioner of Taxes and a Lunacy Commissioner. He sat on the Cranbrook Rural District Council for several years and was a director of the Cranbrook Water Works until the time of his death. During the past year he held the appointment of supervisor of the special constabulary of this district.

He served as captain on the General Reserve from 1914 to 1916 and at one time was commandant of three ships of prisoners of war.

Mr. Hancock joined the A. I. M. E. in 1889.

## Samuel M. Keiper

SAMUEL M. KEIPER, a retired mining engineer, formerly president of the Red Star Powder Co., died suddenly at his home in New York, on Jan. 8, 1921. He was born at Middletown, Pa., 77 years ago.

Mr. Keiper entered the mining field early in life, and followed this work by the manufacture of explosives. He retired from active business about ten years ago.

He became a member of the Institute in 1916, and was a charter member of the Pennsylvania Society.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Dec. 17, 1921 to Jan. 14, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1917 | Arnold, E. C. | Dec. 7, 1921 |
| 1911 | Chase, Fred M. | April 8, 1921 |
| 1881 | Colvin, Verplanck | May 28, 1920 |
| 1905 | Ireland, James D. | Dec. 6, 1921 |
| 1921 | Jennings, C. F. | 1921 |
| 1916 | Keiper, Samuel M. | Jan. 8, 1922 |
| 1913 | Murphy, James K. | 1921 |
| 1921 | Showalter, James Robinson | |
| 1899 | Whitaker, De Bernier | Dec. 25, 1921 |

**Neither Engineers** nor scientific men have any right to prefer their own personal peace to the happiness of mankind; their place and their duty are in the front line of struggling humanity, not in the unperturbed ranks of those who keep themselves aloof from life.—Korzybski.

## Masks Insufficient Protection in Fire-fighting

GASES and vapors may cause three atmospheric conditions dangerous to life. Dr. H. Foster Bain, director of the United States Bureau of Mines, has issued a statement regarding these conditions, in which he gives the following information and advice.

First, in warfare, there are poisonous gases from shells or bombs which, as they are discharged usually in the open air, occur in low concentrations; that is, the actual percentage is small and there is no material depletion of oxygen. This condition was met efficiently by the army gas masks.

Second, in industries, high concentrations of such gases as ammonia, sulfur fumes and carbon monoxide may be encountered through accidents or repair work, though usually there is plenty of oxygen in the air for breathing. This condition may be met by the use of masks with special absorbents. Army masks are valueless for carbon monoxide and high concentrations of ammonia and many other gases.

Third, in confined spaces, such as in tanks, basements and in mines, following explosions or fires, there may be poisonous gases, fumes or inert gases in such quantity that the oxygen content may be so reduced that the atmosphere will not sustain life, independent of the toxic effect of the gases. In this condition, no mask is of any value.

Use of army masks and other masks has led to a number of deaths in fire fighting, in cleaning gasoline tanks, and in entering mines in which there have been fires. Only self-contained breathing apparatus that supplies abundant oxygen is of avail in these places.

A mask has been developed by the Bureau which will allow the wearer to enter smoke and fumes given off in the open air or in large open buildings, but it must be borne in mind that when there is deficiency of oxygen, as in mines after explosions or fires, in confined spaces, in surface fires, in basements or closed rooms or where illuminating gas or gasoline vapor may be present in high concentration, only self-contained breathing apparatus, otherwise termed oxygen breathing apparatus, can be safely used.

Insufficiency of oxygen gives no warning. Rapid changes may occur in the air of a mine after an explosion or during a fire, and a man wearing a gas mask may drop without warning when he encounters an atmosphere deficient in oxygen. The Bureau therefore recommends, on the basis of present evidence, that only self-contained oxygen breathing apparatus should be used in mines following explosions or fires.

There are always men willing to risk their lives to save others who would be tempted to use masks if they were on hand, and the risk is larger than should be taken.

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## A. S. M. E. Annual Meeting

MORE than one hundred professional events, together with numerous social meetings, contributed to the success of the five-day meeting of the American Society of Mechanical Engineers in December.

Elimination of waste in industry, education and training in the industries, engineering education, and topics of special interest to mechanical engineers were discussed at the 19 technical sessions.

The first award of the A. S. M. E. Medal was made to Hjalmar G. Carlson for his invention and part in the production of 20,000,000 Mark III drawn steel booster casings used principally as a component of 75-mm. high-explosive shells, and also extensively in gas shells and bombs.

Honorary membership in the Society was conferred on Henry R. Towne, of the Yale & Towne Mfg. Co.

Dexter S. Kimball, dean of the College of Engineering at Cornell University, was elected president of the A. S. M. E. for the year 1922.

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## Association of Technical Societies founded in Detroit

AFTER several years of thought and discussion, the movement for the affiliation of the architectural, engineering and other technical societies of Detroit was taken up seriously in June, 1921, by the organization of a temporary council composed of two delegates from each of the several societies interested. The affiliation has become an accomplished fact, taking effect Jan. 1, 1922, by the ratification of the proposed Constitution and By-Laws, acceptance of membership and election of Councillors by the following twelve societies: Detroit Section, American Society of Civil Engineers; Detroit Chapter, American Association of Engineers; Michigan Chapter, American Society of Heating and Ventilating Engineers; Detroit Post, Society of American Military Engineers; Detroit Section, American Society of Mechanical Engineers; Detroit-Ann Arbor Section, American Institute of Electrical Engineers; American Institute of Chemical Engineers; Detroit Engineering Society; American Chemical Society and Detroit Chemists; Michigan Chapter, American Institute of Architects; Detroit Section, Michigan Society of Architects; Detroit Chapter, American Society for Steel Treating.

The permanent council met and organized Dec. 13, 1921 and elected officers for 1922 as follows: chairman, P. W. Keating; vice-chairman, A. A. Meyer; secretary-treasurer, Walter R. Meier.

A central office will be established for conducting the business of the several societies. In the past, the meetings of the various societies have often occurred on the same date. This conflict of dates will hereafter be avoided, as the office of the new association will schedule the dates of meetings of all the technical societies. The Associated Technical Societies of Detroit will provide one meeting each month, which will be under the management of one of the member societies.

The paramount use of the new association to its members and to the public is its opportunity for public service both for the city of Detroit and for the state of Michigan. The association will take an active interest in all matters wherein engineering, architectural and technical subjects are an important factor, and will give assistance to city and state officials whenever required.

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## Engineering Section of A. A. A. S. Toronto Meeting

THE meeting in Toronto, Dec. 27–30, of the Engineering Section of the American Association for the Advancement of Science was full of interest and was attended by many representative men of the engineering, geological and university life of the United States and Canada. The chairman of the section is J. B. Tyrrell, member of the A. I. M. E.

At the techincal sessions of the first three days, various engineering subjects were discussed, in papers on natural resources, transportation, power, and mining of coal, metals and oil. The last day's sessions were under the auspices of the Society for Promotion of Engineering Education.

At the dinner on Thursday evening, Mr. Tyrrell was toast master, and the speakers included Dr. F. G. Cottrell, chairman of National Research Council, Washington, D. C.; Sir Robert Falconer, president of the University of Toronto; Prof. E. H. Moore, ex-president of the American Association for the Advancement of Science; Prof. B. E. Livingston, permanent secretary of the American association; Prof. D. T. MacDougal, general secretary of the American association; Hon. H. Mills, Ontario Minister of Mines; Principal M. Hutton, of University College; Prof. C. R. Young and Brig.-Gen. C. H. Mitchell, dean of the Faculty of Practical Science.

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## Free Information

THE Research Information Service of the National Research Council is prepared to supply information about scientific instruments, apparatus and supplies, laboratory construction and equipment.

The following are samples of requests answered recently: "Where may we purchase inexpensive photomicrographic apparatus?" "Where may a human skull be purchased?" "Who manufactures a good grade of selenium cells?"

Address your requests: National Research Council, Information Service, Washington, D. C.

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# Institute Affairs

## The Home of the Institute

ONE DAY early in December, a member of five years standing called at the office of the Institute for the first time since joining. He was shown over the offices, the library, the meeting rooms and auditorium. As he was preparing to leave he remarked, "Mr. Secretary, our excursion through the splendid quarters of the Institute produces two conflicting sensations; the one is that the building graces with becoming dignity an organization to which I have felt it an honor to belong, it is emblematic of my ideal of the Institute; the other is that it looks as though the resources of the Institute, its members' dues, were being used for the purpose of making a show rather than for the objects mentioned in its Constitution."

This observation caused the Secretary to recite a bit of history which it may be wise to repeat for the benefit of other members who have joined the Institute within recent years.

It is now nearly twenty years since Andrew Carnegie became interested in the affairs of the four Founder Societies, the Civil, Mining, Mechanical and Electrical Engineers. He saw them struggling along in cramped quarters, spending much of their income for inadequate office accommodations and, as a result of his observations and the representations made to him, he sent in March, 1904, a letter to the Mining, Mechanical and Electrical Engineers from which the following is quoted.

"It will give me great pleasure to devote, say, one and a half million dollars for the erection of a suitable union home for you all in New York City."

The Civil Engineers did not deem it wise to participate at that time, but the other three national engineering societies proceeded to raise more than half a million dollars with which to purchase the land on which the building was later erected.

Of the equity owned by the Mining Engineers, about 80 per cent. or $400,000, was raised by voluntary contribution, while only about $86,000 has been paid out of dues.

Today the members of the Institute hold a quarter share in a building that could not be duplicated for $3,000,000, and in a library and securities valued at another $1,000,000. The building is used now not only by the four national engineering societies, but by eighteen other engineering societies whose rents largely pay the operating expenses of the building.

In addition to office accommodations, the Institute has available for its meetings an auditorium and a number of smaller rooms suitable for section gatherings and, above all, it has at hand a splendid library of technical literature, so managed that its service is available to every member in every land.

Thus we see that the second thought of our visitor was based on a misconception. It was the generosity

ENGINEERING SOCIETIES BUILDING, NEW YORK CITY.

of Andrew Carnegie and that of a number of our members that gave us an asset which could never have been acquired through the payment of dues, an asset which is in keeping with the character of the organization.

The stars and stripes are emblematic to each citizen of that which he feels the flag should stand for. So with our monumental home; it is merely a show place, or it is a fitting habitation for a dignified and influential organization such as each member strives to maintain.

F. F. SHARPLESS.

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## Related Activities

TO MEMBERS not closely in touch with the work of the Institute, to those who note the long list of boards or committees upon which the Institute is represented, the thought has come sometimes that the Institute may be expending its efforts and resources in directions not contemplated in its Constitution. That this thought should come is not strange, but it would rapidly be dispelled if the questioner had an opportunity to read the Constitution and By-laws of one after another of these organizations and thus learn what each is doing and how its work is being done. He would first learn that he is contributing little or nothing in a financial way to these societies and committees and then he would learn that time, thought, effort, and in some cases financial help are being given liberally and unselfishly by many of his fellow members toward a work that at least they think is well worth the doing.

Of most immediate interest to the Institute, perhaps, is the United Engineering Society, composed of three trustees from each of the four Founder Societies. This Society holds the title to nearly $3,000,000 worth of property belonging to its constituent members and administers trust funds amounting to over $700,000.

The libraries of the four societies were combined and are now cared for by United Engineering Society and a committee of members functioning under its supervision.

In 1914, Mr. Ambrose Swasey of Cleveland offered to the four national engineering societies the sum of $200,000, the income of which should be devoted to research in science and engineering. Another group of men was called upon for service and Engineering Foundation was formed as a part of United Engineering Society to use these funds as seemed wise. The writer had the good fortune to attend a recent meeting of the Foundation and to listen to the discussion of progress which has been made in various lines. Mr. Swasey was present and when asked to speak remarked, "Yes, I have one thing to say. It is most gratifying to me to be here and to realize that such a large number of very busy men are always ready to give so much of their time to a purely altruistic enterprise, without thought of or possibility of reward." Through Mr. Swasey's further gifts, the funds in the hands of the Foundation have grown to $500,000.

National Research Council, created in 1916 as a department of the National Academy of Science, is another of the voluntary organizations in which Institute members take active part. This organization, with the financial assistance of Engineering Foundation and the coöperation of the University of Illinois, as a third party, has recently completed an interesting series of experiments on a limited group of steels. In 1920, the General Electric Co., recognizing the splendid work that was being done, added $30,000 to the funds available and the work has been continued to a broader series of metals. A progress report has been issued by the University of Illinois, as Bulletin 124.

Engineering Council, starting as a joint Conference Committee of the four Founder Societies, was created in 1917 to deal chiefly with non-technical matters. During the war it aided the army and navy and the departments of the Government in selecting techincal men for special service. It assisted the Naval Consulting Board and General Staff in examining 135,000 suggestions and inventions for war service. Since the war it has coöperated with our Employment Bureau and has been active in Washington assisting in the reorganization of departments with the object of economy and simplication. Later, it assisted in the formation of its successor, American Engineering Council, of the Federated American Engineering Societies, whose achievements during the first year of its existence were noted in the December issue of MINING AND METALLURGY.

The federation is an organization to which all members contribute, but their contributions are insignificant compared to the work of individual members who are striving to make it the national mouthpiece of the engineering fraternity.

Members contribute a trifle also to American Engineering Standards Committee, but here again the real support of this organization is the devoted work of the men who are contributing generously of their time and thought to the development of national standards for the benefit of all engineering industries.

And so it goes through all the long list of committees and organizations listed in our Year Book. Most of the names appearing under them are workers and are glad of an opportunity for work on a line of enigneering industry in which they are interested. The lists would be even longer except for the fact that many members have not signified their desire to work on such committees or their ability to do so has not been made known to the officers of the Institute.

Through a questionnaire that was sent out on Dec. 10, it is hoped to learn of the special interest of each member. If the response to this is as full and generous as is hoped for, the information will be most valuable to the officers of the Institute in giving to members that which will be most useful to them and in securing from members that service and knowledge which it is believed that all are ready to give when called upon.

F. F. SHARPLESS.

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## Molding Sand Research

HUNDREDS of thousands of tons of molding and core sands are used annually in the iron, steel and non-ferrous foundries of America. A little of it is re-used; much more might be. Sands are not always correctly selected for specific purposes. Mixing and other treatment can secure improvement. In what

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ways can foundry practice as to sands be bettered? What economies can be realized, not only in reduced expenditure for sand, but also in less number of lost castings and higher quality of accepted product?

Last spring, the American Foundrymen's Association decided that thorough study of this subject would be profitable and asked the coöperation of the American Institute of Mining and Metallurgical Engineers. The Institute referred this request to the Division of Engineering of National Research Council, of which it is a member. Through joint action with the Division, a valuable digest of the literature has been made by Professor Robert E. Kennedy, of the University of Illinois, and a large committee of foundrymen, engineers and scientists has been selected, under the general direction of President W. R. Bean, of the Foundrymen's Association, and the chairman of the Division.

This committee on Molding Sand Research was organized in November, with officers and executive committee as follows:

Chairman, R. A. Bull, Consulting Engineer, Sewickley, Pa.

Secretary, Robert E. Kennedy, Urbana, Illinois, Assistant Secretary, American Foundrymen's Association.

W. R. Dean, Naugatuck, Conn., President, American Foundrymen's Association

Henry B. Hanley, Metallurgist and Chemist, New London, Conn.

Jesse L. Jones, Metallurgist, Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Henry Ries, Professor in Department of Geology, Cornell University, Ithaca, New York.

Bradley Stoughton, Consulting Engineer, New York City.

George K. Burgess, Chief, Division of Metallurgy, Bureau of Standards, Washington, D. C.

The committee has 35 members, representing the many interests in the use of molding sand. The coöperation of men having like interests in Canada and England is assured and invitations have been extended to France and Belgium.

ALFRED D. FLINN.
*Chairman, Division of Engineering, National Research Council.*

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## American Engineering Standards Committee

UNTIL about a year ago the work of the American Engineering Standards Committee was mainly in developing an organization and determining methods by which its work could be made effective. As the whole idea of such a committee was entirely new, much time was required to arrange a procedure that would insure coöperation of the different interests with a minimum of friction. We believe that the progress made in the past year shows that the methods adopted are working well. In several cases in which different bodies had started standardization work on closely related subjects we have been able to get them to work together harmoniously and effectively.

During the year we have established much closer and more satisfactory relations with similar bodies in other countries, and in at least one case a project of international standardization is now under way, with a sectional committee of the A. E. S. C. acting for this country.

Last April, Doctor Agnew, secretary of the committee, attended a conference of the secretaries of the different national standardization bodies, in London. The result of the conference was most satisfactory, arrangements having been made for the prompt interchange of information and for coöperative work in many directions. Following the meeting in London, Doctor Agnew visited the Continent and obtained much interesting and valuable information, particularly in Germany, where standardization is very active. His report on standardization in Germany is now available.

During the year several additional organizations have become members of the committee; others have applied for membership, but their applications have not yet been passed upon by the present member bodies. The committee now consists of 49 members, representing most of the technical and commercial bodies that are actively interested in engineering standardization.

The question of finances is, as with all similar bodies, a difficult one. The expenses of the Committee are not large, the only paid officer being the secretary, who has a small office in the Engineering Societies Building, with a very small force of stenographers. The only other expenses are printing, postage, and traveling expenses of the secretary. The present income is entirely inadequate for the work that should be done, and the finance committee of the A. E. S. C. is actively at work on plans to secure additional income. The Committee fully realizes that many of the member bodies are not in a position to increase their contributions, and that the expenses should be mainly borne by those who benefit most directly by standardization.

Briefly, during the past year:

The Committee has become broadly representative of standardization interests by the inclusion of additional member bodies. It has improved and made more effective its relation with other national standardization bodies. It has materially assisted in securing the coöperation of different bodies interested in the formulation of similar standards. It has lived within its income and is making plans to secure sufficient money to enable it to do the things it was organized to do.

Several correlating committees have been formed that are defining the work of the sectional committees and advising the A. E. S. C. and sponsor bodies regarding it. In all, 37 sponsors have been appointed and and the sectional committees, including representatives of 180 organizations, appointed by them are actively engaged in formulating standards.

GEORGE C. STONE.

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## Neglect of Reduced-fare Privilege Cost Members of the A. S. M. E. $1750

THE following sentences are copied from the news bulletin of the American Society of Mechanical Engineers:

"Out of a registration exceeding 1800 members and guests, less than 350 members who attended the Annual Meeting filed railroad certificates. Thus the fare and a half privilege was not obtained for the 260 who were thoughtful enough to secure and hand in reduced-rate certificates, and who sustained a loss of $1750. It is estimated that $4000 might have been saved by members of the Society if all who were eligible to receive reduced-fare certificates at the time of purchasing transportation to New York had exercised the right.

"The Society itself also might have saved over $1000 in mileage of its members of Council and Sections' delegates, if the fare and a half privilege had been secured."

Unless members of the American Institute of Mining and Metallurgical Engineers are more active in this direction, there will be a similar report after our annual meeting. If you will read the directions either in the January MINING AND METALLURGY or in the announcement sent out on Jan. 20, and will keep in mind the welfare of your fellow members and of the Institute, you will ask for a *certificate* when you buy your ticket to New York.

## Library Book Loans

THE Library Board has adopted rules authorizing the Director of the Library to lend any duplicate books in the Library to members of Founder Societies or of any other societies that contribute to maintain the Library, subject to the following rules:

Books will be lent for 28 days, including time in transit.

Five cents a day will be charged for each book kept longer than 28 days.

Borrowers shall be responsible for books borrowed, and shall pay shipping and insurance charges from and to the Library.

The Library has several thousand volumes that can be lent under this authorization. These include a considerable number of textbooks, reports, etc. of various dates. Periodicals are not included, as the cost of storing duplicate sets seems prohibitive and individual articles can be photoprinted at little expense. The collection is being increased regularly by the addition of suitable duplicates received by the Library. Members are invited to present books of permanent value for this purpose, which they can spare from their libraries. It is hoped that the collection may in time become adequate to meet the usual needs of members by providing standard books for a short time.

No catalog of these books has been published, although it is hoped that one may be printed when the collection becomes extensive enough to warrant it. Until that time, the Director will be glad to receive requests and report as to whether or not the books are available.

HARRISON W. CRAVER,
*Director of Library.*

## Institute Transactions

VOLUME LXIV, containing papers on Non-ferrous Metallurgy and Metallography, has been sent to all members who have asked for it. If there are any members who desire this volume and who have not yet received it, will they please communicate with the Secretary.

Volume LXV, containing papers on Petroleum and Gas, is now in the hands of the binder and will be issued in February.

Volume LXVI, consisting of papers on Mining, Milling, Geology and Coal, is now in the hands of the printer and will be issued early in the year.

Volume LXVII will be printed later in the year.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| **Amer. Inst. Min. & Met. Engrs.** | **New York, N. Y.** | **Feb. 20–23** |
| Amer. Ceramic Soc. | St. Louis, Mo. | Feb. 28–Mch. 3 |
| Canadian Inst. of M. & M. | Ottawa, Ont | Mch. 1–3 |
| Amer. Chem. Soc. | Birmingham, Ala. | April |
| Amer. Welding Soc. | New York, N. Y. | April 27 |
| Iron & Steel Inst. | London, England | May 4–5 |
| Amer. Zinc Inst. | St. Louis, Mo. | May 8–9 |
| Amer. Soc. Mech. Engrs. | Atlanta, Ga. | May 8–11 |
| Foreign Trade Convention | Philadelphia, Pa. | May 10–12 |
| Amer. Foundrymen's Assn. | Rochester, N. Y. | June 5–10 |
| Amer. Soc. for Test. Mats. | Atlantic City, N. J. | June 26–July 1 |

**In the United States,** the coal-mining industry employed 4000 more men in 1920 than in the preceding year. The copper-mining industry suffered a loss of 4000 men; the iron-mining industry, a loss of 1700; and the gold and silver mines, a loss of 2200 men. A loss of 1300 employees occurred in the lead, zinc and fluorspar mines in the Mississippi Valley states. The quarries of the country gained 11,000 employees. There was a loss of 4200 employees at metallurgical plants and 600 at coke ovens. In 1920, all employees averaged a larger number of working days than in 1919. The gain among workers in metal mines averaged 15 days per man. Quarrymen gained 14 days each. Workers at beehive coke ovens gained 32 days per man while those at byproduct ovens gained 18 days each. Coal-mine employees gained an average of 32 days for each of the 780,000 men employed last year.

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# Activities of Local Sections and Affiliations

## Sulfur Discussed for Ohio Section

THE regular meeting of the Ohio Section for the month of December was held on the 19th, in the rooms of the Cleveland Engineering Society. Fourteen members attended the dinner that preceded the meeting, and 40 members and guests were present during the evening.

During the dinner, L. C. Drefahl talked very entertainingly on the subject of sulfur, and gave many interesting facts about the sulfuric-acid industry. In the evening, after various business details had been discussed by the section, the moving picture, "The Story of Sulfur," was shown.

## Story of Tungsten Told for Chicago Section

THE Chicago Section of the A. I. M. E., on Jan. 5, 1922, held a joint meeting with the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, preceded by an informal dinner at the Engineers Club.

Dr. W. C. Blake, chief metallurgist for the Fansteel Products Co., manufacturers of metallic tungsten and molybdenum, addressed the gathering on "The Story of Tungsten." He gave a brief history of the progress that has been made in the metallurgy and uses of this metal, taking up its physical and chemical characteristics and modern commercial applications. He touched on the occurrence of tungsten ores in the United States and outlined the treatment of these to produce concentrates which his company and other manufacturers of tungsten purchase in the open market. These concentrates must be very carefully refined to produce an almost chemically pure tungsten oxide. Doctor Blake explained in detail the interesting process of the reduction of this oxide to the metallic element in an electric furnace, the consolidation of the amorphous powder thus obtained into a billet which is then treated by passage of an electric current to produce cohesion and promote grain growth, and the treatment of the ingot thus obtained, which is swaged to cylindrical form and reduced in diameter by further swaging and drawing through diamond dies.

The talk was illustrated by lantern slides showing the processes in the metallurgy and production of pure tungsten and by some very illuminating photomicrographs showing the grain structure, and grain growth through the application of heat, with later elongation and deformation of the grains through mechanical working. Through the courtesy of the General Electric Co., a film illustrating the manufacture of tungsten lamps was shown.

This was one of the most interesting and successful meetings that the Chicago Section has enjoyed. The total attendance was about one hundred and fifty.

## Copper and Asbestos Interest San Francisco Section

AT THE meeting of the San Francisco Section on Dec. 27, attended by 30 members and guests, the speaker of the evening was Dr. H. W. Morse. His address, on the Present Status of the Treatment of Mixed Copper Ores, was comprehensive and brought out interested general discussion.

On Jan. 10, the section elected its officers for the year. Albert Burch was made chairman; T. J. Hoover, vice-chairman; C. H. Fry, secretary-treasurer; Jules Labarthe and Walter S. Weeks, members of the executive committee.

W. J. Woolsey spoke on Asbestos in California and its Relation to the Quebec Industry, which proved so interesting to his hearers that general discussion was maintained until an unusually late hour for a section meeting. Mr. Woolsey told of the methods of mining and milling asbestos in Quebec, and of the similarity between the Quebec deposits and those of California.

It was decided that the subject for discussion at the next meeting of the section should be Revision of the Mining Law.

## New York Section Votes to Fight Licensing

THE regular monthly meeting of the New York Section was held on Jan. 11, 1922. In the absence of the chairman, in Burma, the vice chairman, William Young Westervelt, presided. There were 65 members and guests present for the dinner and about 90 for the program.

The subject for the evening was "Compulsory Licensing of Mining Engineers—Are You in Favor of Personally Paying $1200 to Secure Licenses to Practice in 48 States?" The speakers were Percy E. Barbour, John M. Goodell, B. Britton Gottsberger, Frederick

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Tabor Rubidge, A. S. Dwight. Others joined in the discussion.

It was moved, seconded and unanimously carried, except one vote to the contrary, that a resolution be addressed to the Board of Directors, and spread on the minutes, as follows:

WHEREAS the Legislature of this State has passed a law requiring that engineers be licensed for the practice of their profession, and

WHEREAS it is our belief that this law or any other law for the licensing of engineers does nothing to improve the status of the engineer and is not required for the protection of the public, and

WHEREAS this law imposes an unjust and burdensome restriction on engineers in the practice of their profession, be it

RESOLVED that the members of the New York Section of the American Institute of Mining and Metallurgical Engineers present in meeting assembled pledge themselves jointly and severally to work for the repeal of this law and to oppose any similar legislation.

RESOLVED that a copy of these resolutions be transmitted to the Board of Directors of the A. I. M. E., with the request that the appointment of a committee of five by the chairman of the section be approved, said committee to plan and carry out measures for the repeal of the New York licensing law, and to this end authorized to receive and disburse funds and to coöperate with other engineering organizations.

## Boston Section Holds Interesting Meetings

THE 70th meeting of the Boston Section was held on Nov. 7. Chairman W. Spencer Hutchinson presided, and 58 members and guests were present.

Professor Hayward gave a brief description of the Chicago meeting of the American Mining Congress and Exposition of Mining Equipment, which he attended.

Prof. Waldemar Lindgren, just returned from South America, gave a talk on the Geology and Mines of Bolivia, and an interesting description of the people of that country, and showed some excellent lantern slides.

At the 71st meeting, on Dec. 5, 40 members and guests were present. The secretary read the report of a plan for consolidating the administrative work and headquarters of the engineering and technical societies of Boston. This plan, prepared by a joint committee of representatives from the various societies, provides for:

1. A consolidation of the administrative work of the societies in the hands of a council consisting of two councillors from each society.
2. The employment of a paid secretary and office force.
3. The use of the present quarters of the Boston Society of Civil Engineers in Tremont Temple building.
4. That the name of the organization be The Associated Technical Societies of Boston.

The advantages and disadvantages of such an arrangement and the obstacles in the way of its accomplishment were discussed, the general sentiment being that such a consolidation is desirable. Considerable doubt was expressed, however, regarding the possibility of making financial arrangements that would not be a serious burden to the Boston Section. A committee was appointed to consider this matter, and to report to the section.

The speaker of the evening, F. W. Denton, vice-president of the Copper Range Co., talked on Mining Methods at the Copper Range Mines, and showed lantern slides illustrating these methods. Many of the photographs for these slides were taken underground. Mr. Denton also showed some interesting pictures of old-time mining devices and equipment, such as the "man-engine" used in the copper country in the early 90's.

## Columbia Section Annual Meeting

AT NOON on Dec. 28, the Columbia Section had charge of the meeting of the Associated Engineers, in Spokane, Wash., at which 85 members and guests were present. D. F. Henderson, president of the Associated Engineers, was in the chair, and Senator Miles Poindexter was the guest of honor.

Rush J. White, Francis A. Thomson, Sidney Norman, and others spoke on Revision of the Mining Law. None favored the proposed revision as a whole, but admitted that some changes in the present law are desirable. Senator Poindexter said that he was glad to have the opinions of local engineers and mining men. He urged that in this period of reconstruction every citizen should aid by constructive suggestion and work, and that each should exercise unusual patience with his neighbor, with Congress and with the Administration.

In the evening, the eleventh annual meeting of the Columbia Section was held at the Davenport Hotel, Spokane, beginning with a dinner at which about twenty ladies were present as guests of the members. At the business session following the dinner, chairman Ivan de Lashmutt presided. Officers for the next year were elected as follows: Rush J. White, chairman; Frank M. Smith, vice-chairman; L. K. Armstrong, secretary-treasurer.

The subject for the evening was "The Geology of the Northwest, with Special Reference to the Economic Possibilities." The principal address was made by Prof. O. P. Jenkins, associate professor of economic geology at the State College of Washington. Professor Jenkins said, in part:

It is a mistake to consider geology as a subject limited only to the study of the occurrence of mineral deposits. To be sure, that phase of the work is vital, but we should not limit our viewpoint in that manner. The Spokane Falls are a geological feature, and they were, I understand, instrumental in the location of this city. The Palouse country, with its great wheatfields, exists because of the occurrence there of one of the greatest basalt flows of the world, and because fertile soil is formed from the weathering of basalt under favorable conditions. Puget

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Sound, with its bordering cities, fairly boiling over with industry, exists because of a subsidence of the land and an encroachment of the ocean water into old stream channels. Hardly a single industry may be established that is not directly or indirectly affected by geological conditions.

I find that the greatest handicap we engineers and geologists have to contend with is that we do not know the detail of industry. I mean that if we knew just what industries exist in the country, what mineral products they use and need, just how these mineral products are used in each industry and what substitutes could be used instead if secured for a smaller price, I believe we could find a large part of the requisites near at hand and thus save considerable expenditure to the industry. On the other hand, the industries seldom have any idea of what we could do for them, for they generally know little or nothing of geology. To better this situation we need a general clearing-house both for industrial information and for detailed data regarding mineral occurrence.

Professor Jenkins showed many lantern slides of natural phenomena that have been made to serve useful purposes in the growth of the state of Washington.

Virgil R. Kirkham, petroleum geologist of the Department of Geology at the University of Idaho, and assistant geologist for the State Bureau of Mines and Geology, made a brief address, in which he said:

The Idaho Bureau of Mines and Geology has authorized an investigation of all territories in the state that have suffered an acute oil excitement. Competent and conservative petroleum geologists recognize five factors or conditions indispensable to the accumulation of oil or gas in rocks. These are: 1. A source of origin; 2. A reservoir or containing rock; 3. An impervious capping; 4. A suitable structure; 5. A high water saturation. As a result of its official investigations, the Idaho Bureau has concluded that none of the localities of northern Idaho have all of these essential requirements of an oil-producing area.

At Lewiston, Idaho, the elements necessary for the formation of oil are lacking. The well is not drilling in marine sedimentary beds, but in lava flows of basalt. There is absence of a good reservoir rock in basaltic formations. The folds are without closure and are not likely to trap oil were it present.

Farther south along the Snake River, in the neighborhood of Pittsburgh Landing, the situation is essentially the same. The older Permian volcanics appear below the tremendous basalt flows in that area, but do not lend themselves any more favorably to the origin of oil than the latter. Favorable structure is not present at this locality.

In Bonner County, an examination of the geology has proved the rocks to be unfavorable structurally or as reservoir rocks for containing oil. The extreme age of the sedimentary beds, as evidenced by their deformation and metamorphism coupled with lack of fossils, has caused eminent geologists to believe them to have been formed during pre-Cambrian or Cambrian time. Analyses of a large number of gas samples by the U. S. Bureau of Mines and a consideration of the manner of occurrence of the gas in this county has led the State Bureau to conclude that the gas is not from a petroliferous source, but is a marsh gas derived from decaying organic matter buried in the fluviatile deposits.

In summary, I am authorized by Dean Francis A. Thomson, the director of the Bureau, to say that the Bureau of Mines and Geology believes the geology of northern Idaho to be unfavorable for the accumulation of petroleum and natural gas in commercial quantities.

In the week preceding the annual meeting, on Dec. 16, the Columbia Section held a noon meeting at which 20 members were present. J. H. Eby read a short paper on some geologic phenomena in the vicinity of Wardner, Idaho, and showed several maps.

## Affiliated Student Societies

**Miners Club,** University of Arizona, heard an interesting address on oil geology and the possibilities in oil engineering, by Dorsey Hager, on Nov. 30.

**Mining and Metallurgical Society,** Pennsylvania State College, held a meeting early in October, made arrangements for a number of smokers, and elected the following officers: R. B. George, president; W. Davis, vice-president; E. M. Gingerich, secretary-treasurer.

**The Crucible Club,** University of Nevada, has been recognized as an affiliated student society of the A. I. M. E. The members of the club are upper class students of the Mackay School of Mines, University of Nevada, members of the mining faculty and employees of the Reno station of the U. S. Bureau of Mines. Meetings are held monthly. Ernest Harker, president, and James W. Byrkit, Jr., are officers for this year.

**Princeton Engineering Society,** Princeton University, is also a new affiliated student organization. The officers are A. L. Dyer, president; W. F. Dittig, secretary; and F. C. Baselt, treasurer.

**Miners Club,** Oregon State Agricultural College, gave a smoker on Oct. 20. There was no technical program. The Miners Club and the staff of the School of Mines have planned a dinner and smoker at which they will be the hosts of the Oregon Local Section of the Institute.

**Junior Association, Ohio State University.**—At the first meeting of the Junior Association, Professors Nold and Demorest, of the Departments of Mining Engineering and Metallurgy, agreed to dismiss classes for one hour on Friday afternoons for the discussion of topics outside the range of study in the departments. These discussions are to be held by the Junior Association and to be participated in by all. The first topic was "The Relation of the Engineer to Capital and Labor." It was a big success, with much discussion and many new ideas.

The Association held its annual banquet on Nov. 8. Over 40 students, and 10 professors as their guests, enjoyed the evening.

The Association has shown five of the Bureau of Mines moving pictures at its bi-weekly meetings at Lord Hall and has had the pleasure of hearing Doctor Shaw, assistant chief chemist of the Bureau of Mines, speak on the Bureau of Mines.

**Minnesota School of Mines' Society.**—At a recent meeting, F. W. Holler, superintendent of the Surf Inlet mines of the Tonopah Belmont Co., spoke to the Society regarding the exploration and development of these properties. The mine is at Surf Inlet, B. C., 10 mi. from tide water, and when the Tonopah Belmont Co. took an option on the claims about seven years ago, they were confronted with a very serious transportation problem. This was solved by the construction of a concrete dam which furnished a source of power for the generating plant, and backed up the

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water sufficiently to form a connection between two lakes and provide a water route for barge transport, supplemented by a short rail haul at each end. Mr. Holler also outlined the plan followed in the exploration work, and the development program carried on after a considerable amount of satisfactory ore had been located.

On Nov. 15, Tom Lovering, '22, addressed the Society on the geology of the coastal regions of Newfoundland. Mr. Lovering was a member of a geological reconnaissance party sent to Newfoundland by Yale University in the summer of 1920 to study the Ordovician and the Cambrian, and the general relations of the west coast of Newfoundland and eastern Labrador. He gave a brief description of general conditions, and also described the occurrence of the Wabana iron ores and mining methods at the mines on Isle Royal. W. R. Griswold, '23, spoke briefly on Methods of Sampling of Narrow Vein Deposits.

On Nov. 22, Frank E. Mooney, '23, gave the Society a description of the electrolytic zinc plant of the Anaconda Copper Mining Co. at Great Falls.

On Dec. 1, George Hezzelwood, '23, addressed a Society meeting on Railroad Tunneling in British Columbia. He dealt particularly with an attempt made by the contractors of a Grand Trunk grade construction in 1913 to tunnel through a shoulder of the Selkirk Range in the Fraser River Valley. The course of the tunnel was through loose, unconsolidated materials, mainly clays, and, because of excessive distortion and floor bulge, the project was abandoned when only about 25 per cent completed. The speaker gave a description of some of the obstacles to be expected in soft ground tunneling, and the advisable timbering methods.

**Mining and Geological Society,** Lehigh University, elected its officers for the year 1921–22 at a meeting held on May 19: president, H. C. Beekel, vice-president, E. N. Lamb; secretary, J. M. Newlin; treasurer, B. H. C. Johnson; curators, W. M. Walters and W. M. Glick. The speaker at this meeting was Robert P. Sanborn, manager of the traction department, Edison Storage Battery Co., who spoke on the application of storage batteries to mine haulage.

On Oct. 27, H. A. Reichenbacher gave an interesting talk on pulverized coal and its utilization, illustrated by lantern slides; and on Dec. 1, Dr. J. M. Payne addressed the Society on the subject of Mexico. Doctor Payne showed many views and told many amusing incidents. At the last meeting, J. A. Thomas was elected secretary in place of J. M. Newlin, resigned.

## Woman's Auxiliary

THE regular monthly meeting of the General Council of the W. A. A. I. M E. was held on Thursday, Jan. 5, 1921. There were nine members present. A letter was read from Mrs. Jüssen, provisional director of the Northern California Section, who reported 142 cards of invitation sent out and the formation of a section under way.

Mrs. Philip Wiseman, director of the Southern Californian Section, was present and made an informal report on the activities of this section, which has 62 members. At the monthly luncheons there is usually a talk by a member who has lived in remote mining camps: a relation of her experiences. Recently a member told of her life in Burma, showing native embroideries and curios. This section made, in a month's time, 300 garments for the Red Cross, which were sent to Russia. As a unit of the Needlework Guild of America, this section of the W. A. A. I. M. E. contributed 110 garments last autumn.

The Denver Section reported by letter. A contribution of $182 was sent to the Educational Fund. A committee was appointed, at Thanksgiving time, to receive donations for any engineers who might be in the hospital for tubercular ex-service men.

The Butte Section reported, by letter, the establishment, in July, 1921, of a free kindergarten in the foreign district, three rooms in the school building being provided through the courtesy of the school board. The daily attendance averaged 25. On three mornings in the week a sewing class was held, with 15 girls in attendance. One of the mining companies donated over 100 yards of unbleached muslin for garments. For every dollar donated by individuals to the Community Chest, the mining companies donated a dollar and a half. One committee of this section, headed by Mrs. Norris, calls itself "The Neighbors," and has become a strong factor in Americanization work.

The Anaconda Section made no report.

The Utah Section reported that regular meetings have been held. It is expected that an annual entertainment will be given for the benefit of the Educational Fund, which this section considers "the prime interest of the Auxiliary." The desire of this section is, "that any effort made by it toward local betterment, should, whenever possible, have a bearing on the mining element in the community."

The appointment of Mrs. Jennings as representative of the Washington, D. C. section was confirmed by the Council.

Mrs. Jennings' report, as chairman of the Educational Fund Committee, follows.

CLARE C. REYNDERS,
*Secretary.*

### REPORT OF EXECUTIVE COMMITTEE OF EDUCATIONAL FUND OF W. A. A. I. M. E.

The Executive Committee of the Educational Fund reports that the governing authorities of Columbia University offered to the Directors of the A. I. M. E. the privilege of naming the recipient of a scholarship for the study of mining or metallurgy in the School of Mines, Metallurgy and Chemistry of Columbia Univer-

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sity, New York, of the value of $350 yearly to cover the cost of tuition.

The Board of Directors of the A. I. M. E. passed a resolution to the effect that the Advisory Board to the Executive Committee of the Educational Fund of the Woman's Auxiliary of the A. I. M. E. be requested to coöperate with the said committee in seeking suitable candidates for appointment, the final choice to be subject to approval by the Board of Directors of the Institute.

In order that this scholarship may more adequately carry out the ideas of the Woman's Auxiliary, the Educational Committee is adding to it the sum of $200 yearly to be granted under the rules for the administration of the Educational Fund, the value of the scholarship being thus raised to $550 per annum.

Letters and notices have been sent to the various sections of the Woman's Auxiliary and to the Student Societies affiliated with the A. I. M. E., inviting applications for the scholarship and stating the requirements and conditions.

Applications must be mailed not later than March 1, with all supplementary and endorsing letters, to Mrs. S. J. Jennings, Chairman of the Educational Fund, 44 East 80th Street, New York City. This mail should be registered. Applications mailed later than March 1 cannot be considered.

The midyear report of the holder of our scholarship to the University of California is most satisfactory.

AMY F. JENNINGS,
*Chairman.*

# Government Papers of Interest to Engineers

## Investigations by the Bureau of Mines*

**Reduction Mills in Western States in 1920.** (Serial No. 2287).—In 1912 an investigation was made by the United States Geological Survey as to the number of reduction mills in the various western states, with details of their equipment, and the results were published in the Mineral Resources report of that year. The present list was compiled by Charles G. Yale, V. C. Heikes, and Chas. W. Henderson of the U. S. Geological Survey, and is being published by the U. S. Bureau of Mines for the benefit of the industry. Strict accuracy in details is not claimed for the present list of reduction mills, as in the limited time at disposal it was not always possible to send for corrections or additional information. The list, however, may be considered a revision of that of 1912.

The list for each state has been bound separately and given a subtitle, and the following are available:

| | | |
|---|---|---|
| Serial | 2287–A | California |
| | 2287–B | Oregon |
| | 2287–C | Washington |
| | 2287–D | Idaho |
| | 2287–E | Utah |
| | 2287–F | Montana |
| | 2287–G | Nevada |
| | 2287–H | Arizona |

**Utilization of Waste Slate as a Filler** (Serial No. 2283). By Oliver Bowles.—All of the information available indicates that waste slate may be used to advantage as a filler in mechanical rubber goods and in some classes of oil-cloths, floor coverings and window shades. Apparently it is not adapted for use in rubber of a grade used in automobile tires. For plastic roofing and flooring products containing coal tar it has long been in use and constitutes a very satisfactory filler.

**Miners' Field Day, Butte, Montana** (Serial No. 2286). By D. Harrington.—In order to stimulate general interest in mine safety among their employees, the mining companies of Butte, Mont., instituted in 1918 a Miners' Field Day, and this field day has since been held annually about the end of July. This paper is an interesting account of the way in which the Miners' Field Day in the Butte district is organized, with data on costs, plan of organization, method of conducting, and the practical benefits derived from it.

**Hot High-nitrogen Gas in a Metal Mine** (Serial No. 2282), By G. E. McElroy.—While investigating the presence of heavy strata gases in certain mines of the East Tintic mining district of Utah, a small, local body of light, very hot gas of high-nitrogen composition was noted in one of the mines. Observations and analyses indicate that this light gas was resulting from very rapid oxidation of finely disseminated pyrite, in lead-silver sulfide ore. The gas was actually mine air that had lost a large proportion of its oxygen content by reaction with the pyrite. This body of gas was hanging in a local high spot about 5 by 5 by 5 ft. in size, caused by caving, at the end of a crosscut. Fifty feet from this spot, an air current of 6000 cu. ft. per min. was entering the 5 by 7 ft. crosscut from a raise from below.

The analyses and the air-free calculations made show that the gas is black damp (defined by Haldane, the English physiologist, as an accumulation of carbon dioxide and nitrogen in proportions larger than those found in atmospheric air) composed almost wholly of nitrogen.

*Reports in full may be obtained from the Director of Bureau of Mines, Washington, D. C. Give serial number.

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# Increase of Membership Department

**Total membership as of Dec. 31, 1921, is 10,205**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period Dec. 18, 1921 to Jan. 20, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—Lawrence Gould Blodgett,** Tulsa, Okla.
Present position—1919 to date: Manager, Operating Department, H. F. Wilcox Oil & Gas Co.
Proposers: J. W. Merritt, James H. Hance, U. S. Grant.

**2—John Briscoe Brown,** Puerto Mexico, Ver., Mexico.
Present position—1920 to date: Scout, Geological Department, Transcontinental Petroleum Co.
Proposers: Joseph T. Singewald, Jr., William A. Baker, Jr., Max W. Ball.

**3—Barnabas Bryan,** Brooklyn, N. Y.
Present position: Associated with Ralph Arnold, New York, N. Y.
Proposers: Carl B. Anderson, Lucius W. Mayer, Eugene H. Dawson.

**4—Robert C. Coffey,** Kirkland Lake, Ontario, Canada.
Present position—1918 to date: Manager, Lake Shore Mines, Ltd.
Proposers: Walter E. Hurd, Percy E. Barbour, Arthur W. Jenks.

**5—Llewellyn Dana Davenport,** Duluth, Minn.
Present position: Consulting Engineer.
Proposers: W. R. Appleby, W. H. Emmons, Frank Hutchinson.

**6—Charles Hollister Davis,** Cheshire, Conn.
Present position—1919 to date: In charge of Waterbury Laboratory of the American Brass Co., Waterbury, Conn.
Proposers: W. H. Bassett, J. C. Bradley, F. G. Smith.

**7—Elmer Harrison Finch,** Monrovia, Cal.
Present position—1920 to date: Geologist, Matador Petroleum Co., Cheyenne, Wyoming.
Proposers: Justus H. Cline, E. F. Davis, Max W. Ball.

**8—Jesse Garrett Gilley,** Pikeville, Ky.
Present position—1920 to date: Chief Engineer, C. G. Evans, Consulting Civil and Mining Engineer.
Proposers: A. J. Baldwin, Charles E. Krebs, J. M. Clark.

**9—Patrick A. Grady,** Huntington, W. Va.
Present position: Consulting Engineer, J. C. Sullivan's Interests, Tralee, W. Va.
Proposers: Charles E. Krebs, J. M. Clark, Ernest M. Merrill.

**10—Roy Jack Grissom,** Pulacayo, Bolivia.
Present position: Mine Superintendent, Cia. Huanchaca de Bolivia.
Proposers: C. Leonard Ball, Charles A. Mitke, John M. Sully.

**11—Edward Patterson Hall,** Phillipsdale, R. I.
Present position—1919 to date: Metallurgist, American Electrical Works.
Proposers: Daniel Boyd, Augustus H. Eustis, F. A. Eustis.

**12—George Martin Hall,** Baltimore, Md.
Present position—1921 to date: Assistant Geologist, United States Geological Survey, in charge of underground water resource work in South Central Montana.
Proposers: Joseph T. Singewald, Jr., Edward B. Mathews, Joseph K. Roberts.

**13—Herbert Brinley Husband,** Dorothy, W. Va.
Present position: Chief Mining Engineer, Chesapeake & Ohio Railway Co., Fuel Mine Operations.
Proposers: R. C. Cofer, E. L. Colcord, L. A. Gates.

**14—William Albert McCullough,** Cleveland, Ohio.
Present position: Mining Engineer on Staff of Crowell & Murray.
Proposers: C. B. Murray, Herbert M. Boylston, L. E. Dunham.

**15—John S. McKeever,** Longacre, W. Va.
Present position—1916 to date: General Superintendent, Kanawha & Hocking Coal & Coke Co.
Proposers: Charles E. Krebs, J. M. Clark, Ernest M. Merrill.

**16—Thomas George Madgwick,** Birmingham, England.
Present position—Professor of Petroleum Technology, Birmingham University.
Proposers: John Cadman, Edwin Ludlow, F. F. Sharpless.

**17—Vincent T. Malcolm,** Indian Orchard, Mass.
Present position: Metallurgist in charge, Chapman Valve Mfg. Co.
Proposers: W. M. Corse, Robert F. Wood, F. P. Gilligan.

**18—Alfred Blake Maury,** New York, N. Y.
Present position—1921 to date: Sales Engineer, Herreshoff Furnace Department, General Chemical Co., and Designing Engineer.
Proposers: Robert H. Cromwell, H. V. Smythe, Louis deB. Lovett.

**19—Walter Millwater,** Arboretum, Worcester, England.
Present position—1920 to date: Manager of Sengie Ayan Tine Mine, Trenggame, Malaya.
Proposers: James Thame, J. F. Mitchell-Roberts, R. O. Stokes.

**20—Charles Riggs Morris,** Virginia City, Nev.
Present position—1917 to date: Mill Superintendent, Mexican Milling Co.
Proposers: S. H. Ball, Alexander Wise, R. A. Hardy.

**21—George Howard Pratt,** Los Angeles, Cal.
Present position—1912 to date: Conducting own assay office.
Proposers: Arthur B. Maxwell, S. Paul Lindau, Edward D. Lynton.

**22—Frank W. Reeves,** Fort Worth, Texas.
Present position—1919 to date: Consulting Geologist and Engineer.
Proposers: D. M. Folsom, Wallace E. Pratt, Carlton Meredith.

**23—Oliver H. Runk,** Mexico, Ky.
Present position—1918 to date: Superintendent, Haffaw Mine for Aluminum Ore Co. of East St. Louis.
Proposers: C. W. Haynes, A. H. Reed, Blakeslee Barnes.

**24—Harry Schagrin,** South Charleston, W. Va.
Present position—1920 to date: Chief Chemist, U. S. Naval Ordnance Plant.
Proposers: Walter H. White, W. J. Priestley, Frank T. Sisco.

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**25—Henry Seidler,** New York, N. Y.
Present position: With Purchasing Department, Cerro de Pasco Copper Corpn.
Proposers: E. E. Thum, J. W. Mercer, Marshall S. Walker.

**26—Arthur Percival Tanberg,** Henry Clay, Del.
Present position—1920 to date: Director, Experimental Station, E. I. duPont deNemours & Co.
Proposers: W. C. Spruance, Hamilton Bradshaw, Frank S. MacGregor, G. B. Street.

**27—Richard Henry Thomas,** Orange, N. J.
Present position—1913 to date: Superintendent, Bay Plant, Copper Department, Balbach Smelting & Refining Co., Newark, N. J.
Proposers: E. E. Dieffenbach, R. von Seyfried, R. A. Bingham.

**28—Frederick William Trezise,** Appleton, Wis.
Present position: In charge Engineering Instruction, Lawrence College.
Proposers: Rufus M. Bagg, Harold O. Davidson, Thomas W. Orbison.

**29—Jitaro Yonezawa,** New York, N. Y.
Present position—1911 to date: Professor of Mining, The Osaka Higher Technical School, Japan.
Proposers: Shidzuo Komuro, Tatsuro Otagawa, Kenroku Ide.

Associates

**30—Henry Ernest Brauer,** Palmerton, Pa.
Present position—1921 to date: Metallographic Investigator in Metal Sections of the Research Division of the New Jersey Zinc Co.
Proposers: W. M. Peirce, William H. Finkeldey, W. C. Harpster.

**31—William Joseph O'Toole,** Welch, W. Va.
Present position—1920 to date: Vice-President and Manager of Sales, Central Pocahontas Coal Co.
Proposers: Charles E. Krebs, J. M. Clark, Ernest M. Merrill.

**32—Edward E. Thalmann,** Ardsley-on-Hudson, N. Y.
Present position—1919 to date: Bates Iron Co., Assistant to the President; Florence Iron Co., Assistant to the Vice-President. At present—General Briquetting Co., Vice-President and Assistant Treasurer; Ohio Metal Briquetting Co., Treasurer; Schermuly Polarisator Corpn., Vice-President; New York Pyrites Co., Vice-President.
Proposers: F. T. Rubidge, Albert L. Stillman, R. M. Atwater, Jr.

**33—William Joseph Thompson,** Bethlehem, Pa.
Present position—1919 to date: Secretary, Anthracite Coal Operators Assn., Philadelphia, Pa.
Proposers: E. W. Parker, A. H. Armstrong, Alan C. Dodson.

Junior Associates

**34—Benjamin Adelstein,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Earl B. Young, Theodore Simons, H. T. Mann.

**35—Hermann Charles Beeckel,** Philadelphia, Pa.
Student, Lehigh University, Bethlehem, Pa.
Proposers: Howard Eckfeldt, Benjamin L. Miller, H. B. Pulsifer.

**36—Lester Farragut Bishop,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Theodore Simons, E. B. Young, H. T. Mann.

**37—Alex. Grove Brockway,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: H. T. Mann, Earl B. Young, Theodore Simons.

**38—Carl Frank Buchner,** Madison, Wis.
Student, University of Wisconsin.
Proposers: E. R. Shorey, Richard S. McCaffery, A. N. Winchell.

**39—Walker Bryson Carroll,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: H. T. Mann, Theodore Simons, A. E. Adami.

**40—Alvis F. Denison,** Cushman, Ark.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**41—Thomas Chadbourne Denton,** Cambridge, Mass.
Student, Harvard Engineering School.
Proposers: H. L. Smyth, Albert Sauveur, L. C. Graton.

**42—George Fanta,** Cleveland, Ohio.
Student, Case School of Applied Science.
Proposers: Anthony Jenkin, Kenneth H. Donaldson, H. M. Boylston.

**43—Howard Chandler Fleck,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, C. L. Dake, J. R. Guiteras.

**44—Emil Gustav Hanson,** Socorro, New Mex.
Student, New Mexico State School of Mines.
Proposers: W. G. Ramlow, T. W. Quayle, Cony T. Brown.

**45—Lorin Lindley Hawes,** Socorro, New Mex.
Student, New Mexico State School of Mines.
Proposers: W. G. Ramlow, T. W. Quayle, Cony T. Brown.

**46—Henry G. Hubbard,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, C. L. Dake, J. R. Guiteras.

**47—F. K. Middleton Hunter,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**48—Paul Lewis Keller,** State College, Pa.
Student, Pennsylvania State College.
Proposers: E. S. Moore, C. A. Bonine, William R. Chedsey.

**49—Gerald Maitland Kenvair, Jr.,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: H. T. Mann, Earl B. Young, Theodore Simons.

**50—Irwin Wikon Keyes,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, C. L. Dake, J. R. Guiteras.

**51—Kenneth Knight Laudes,** Cambridge, Mass.
Student, Harvard University.
Proposers: H. L. Smyth, Alfred Wandke, L. C. Graton.

**52—Robert Carl Lentz,** Madison, Wis.
Student, University of Wisconsin.
Proposers: E. R. Shorey, Richard S. McCaffery, A. N. Winchell.

**53—Ramon Gregorio Marquez,** Madison, Wis.
Student, University of Wisconsin.
Proposers: E. R. Shorey, Richard S. McCaffery, A. N. Winchell.

**54—Richard Moldenke, Jr.,** Watchung, N. J.
Student, Columbia University.
Proposers: James F. Kemp, Charles P. Berkey, R. J. Colony.

**55—Raymond Edward Murphy,** Rolla, Mo.
Student, Missouri School of Mines and Metallurgy.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**56—Lanfear Barbey Norrie,** Cambridge, Mass.
Student, Harvard Engineering School.
Proposers: H. L. Smyth, G. S. Raymer, L. C. Graton.

**57—John Alfred Potter, Jr.,** Stanford University, Cal.
Graduate Student, Stanford University.
Proposers: W. F. Dietrich, W. H. Shockley, Welton J. Crook.

**58—Bruno Rixleben,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, Joseph R. Guiteras, C. L. Dake.

**59—Edwin A. Thomas,** New York, N. Y.
Student, Columbia University.
Proposers: E. S. Moore, D. F. McFarland, William R. Chedsey.

**60—Edward Torrence, Jr.,** Rolla, Mo.
Student, Missouri School of Mines and Metallurgy.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**61—Leonard Oliver Walde,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: H. T. Mann, E. B. Young, A. E. Adami.

**62—George Andrews Warner,** Socorro, N. Mex.
Student, New Mexico State School of Mines.
Proposers: W. G. Ramlow, T. W. Quayle, Cony T. Brown.

**63—Donald Boardman Weir,** Pullman, Wash.
Student, Washington State College.
Proposers: L. O. Howard, C. G. Warfel, L. K. Armstrong.

**64—Frederick William Wiegand,** Boston, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Charles E. Locke, W. Lindgren, Carle R. Hayward.

**65—Joseph Frank Wosehutz,** Madison, Wis.
Student, University of Wisconsin.
Proposers: E. R. Shorey, Richard S. McCaffery, A. N. Winchell.

**66—Arthur John Yahn,** Madison, Wis.
Student, University of Wisconsin.
Proposers: Richard S. McCaffery, Edward R. Shorey, A. N. Winchell.

Change of Status—Associate to Member

**67—Samuel Jefferson Caudill,** Tulsa, Okla.
Present position—1920 to date: Consulting Geologist and Petroleum Engineer.
Proposers: George C. Matson, Alf. G. Heggem, James H. Gardner.

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**68—Archie J. McDermid,** Quartzburg, Idaho.
Present position—1920 to date: Mining Engineer, Gold Hill & Iowa Mines Co.
Proposers: Victor J. Lynch, E. E. Carter, E. W. McCullough.

**69—Andrew Nicholls Mackenzie,** Pasadena, Cal.
Present position: Graduate Student, Geology, Stanford University.
Proposers: C. F. Tolman, Jr., W. F. Dietrich, Welton J. Crook.

Change of Status—Junior Associate to Member

**70—Samuel McKirahan,** Rapid City, So. Dak.
Present position—1921 to date: Manager, National Engineering & Refining Co.,
Proposers: F. W. Traphagen, W. C. Bochert, C. C. O'Harra.

# Engineering Societies Library

HARRISON W. CRAVER, Director

## A List of Books on the Electron*

COMPILED BY HARRISON W. CRAVER

This list owes its origin to a suggestion from Professor V. Karapetoff, of Cornell University, that a brief list of references would be useful to students of electrophysics.

It is intended as a guide to some of the more important books on the electron; books from which a correct understanding of present knowlecdge about the nature and properties of electrons may be obtained. No attention has been paid to the numerous important articles that have appeared in periodicals.

Professor Karapetoff and Professor E. Merritt, also of Cornell University, have assisted materially by evaluating the longer list from which selection has been made, and the final list has their approval. Whatever merit it may have is due to their intelligent, helpful criticism.


Abraham, M. "Theorie der Electrisitat." Ed. 3. 1914. Leiprig, Teubner. 10 M.
Allen, H. S. 'Photo-Electricity." 1914. New York, Longmans. $2.10.
Campbell, N. R. "Modern Electrical Theory." Ed. 2. 1914. New York. Putnam. $2.75.
Comstock, D. F. & Troland, L. T. "Nature of Matter and Electricity." 1917. New York, Van Nostrand Co. $2.00.
Cox, John. "Beyond the Atom." 1913. New York, Putnam. $0.40.
Crowther, J. O. "Ions, Electrons and Ionizing Radiations." 1920. New York, Longmans. $4.00.
Cunningham, E. "Relativity, the Electron Theory and Gravitation." Ed. 2. 1921. New York, Longmans. $3.50.
Curtis, H. A. "Electron Theory." 1912. Denver, Colorado Scientific Society.
Fleming, J. A. "Thermionic Valve and its Developments in Radio-Telegraphy and Telephony." 1919. London, Wireless Press. 15s.
Hughes, A. L. "Photo-Electricity." 1914. Cambridge University Press.
Lamor, Joseph. "Aether and Matter." 1920. London.
Lodge, O. J. "Electrons." 1907. New York, MacMillan. $2.00.
Lorentz, H. A. "Theory of Electrons." 1909. New York, G. E. Stechert. $2.50.
Millikan, R. A. "The Electron." 1917. Chicago, University of Chicago Press. $1.50.
Perrin, J. B. "Atoms." 1917. New York, Van Nostrand. $2.50.
Ramsay, William. "Elements and Electrons." 1912. New York, Harper. $0.75.
Richardson, O. W. "Electron Theory of Matter." Ed. 2. 1916. New York, Putnam. $4.50.
—— "Emission of Electricity from Hot Bodies." 1916. New York, Longmans. $2.75.
Rutherford, Ernest. "Constitution of Matter and the Evolution of the Elements." 1916. Washington, Smithsonian Institution. Free.
—— "Radioactive Substances." 1913. New York, Putnam. $4.50.
Soddy, Frederick. "Interpretation of Radium." Ed. 4. 1920. New York, Putnam. $3.75.
—— "Matter and Energy." 1912. New York, Holt. $0.75.
Thomson, J. J. "Conduction of Electricity Through Gases." Ed. 2. 1906. New York, Putnam. $4.00.
—— "Corpuscular Theory of Matter." 1907. New York, Scribner. $2.00.
Townsend, J. S. "Electricity in Gases." 1915. New York, Oxford University Press. $4.75.


*Reprinted from the *Journal* of the American Institute of Electrical Engineers (January, 1922).

## Book Notices

**Automobile Engineering.** Chicago, American Technical Society, 1920. 6 vols., illus., 8 × 6 in., fabrikoid, $29.80.

A course for self-instruction and a book of reference covering the maintenance and operation of automobiles of all kinds. Information is presented clearly and without mathematics, and is illustrated by many cuts and drawings. Earlier editions were entitled "Cyclopedia of Automobile Engineering."

**Bleaching.** By J. Merritt Matthews. N. Y., Chemical Catalog Co., Inc., 1921. 676 pp., illus., 9 × 6 in., cloth, $8.

The author has attempted to give the main facts relating to the bleaching of a variety of materials, and to discuss these facts from the practical point of view of the textile chemist and the actual operative in the mill. The greater part of the book deals with the bleaching of textiles, but other vegetable fibers and materials, such as straw, leather and bone, are also discussed.

**Compteurs de Vapeurs.** By E. Hoehn. Paris, Ch. Béranger 1921. 34 pp., illus., 9 × 6 in., paper, 2 fr.

This pamphlet by the chief engineer of the Swiss association of boiler owners describes the theory and operation of ordinary and recording steam meters, and notes the advantages and disadvantages of the different types.

**Cours de Mécanique Rationelle.** By Louis Roy. Paris. Gauthier-Villars et Cie, 1921. 259 pp., 10 × 6 in., paper,

This volume and the author's previous book on graphic statics and strength of materials form a course of instruction in mechanics for students of engineering. The present work is for beginners and is confined to the elements of mechanics, which it presents so that students will have the grounding necessary for the study of applied mechanics, general physics and electrical engineering.

**Detailed Report on Nicholas County.** By David B. Reger. West Virginia Geological Survey, P. O. Box 848, Morgantown, W. Va. 847 pp. + xx pp. introductory matter. 34 half-tone plates and 22 zinc etchings in text, accompanied by a separate case of topographic and geologic maps. Price, including case of maps, delivery charges paid by the Survey, $3. Extra copies of topographic map, $0.75; of the geologic map, $1.

Nicholas County contains the New River Coal Group, the Kanawha Group and the lower members of the Allegheny series in its northern portion. This report contains a chapter on the paleontology of Nicholas County and a short description of the chert deposits of West Virginia by Dr. W. Armstrong Price.

**Economics of Petroleum.** By Joseph E. Pogue. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 375 pp., plates, illus., 9 × 6 in., cloth, $6.

The purpose of this book is to present the more important economic facts relating to petroleum, to interpret the changes taking place in the industry and to forecast the future trend of these changes. It contains useful information on our resources, the trend of development, production and refining, transportation, prices, trend of consumption, and similar topics.

**Elementary Chemical Microscopy.** By Émile Monnin Chamot. Second edition, partly rewritten and enlarged. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 479 pp., illus., 9 × 6 in., cloth, $4.25.

Intended as an introduction to the microscope and its accessories as tools for the chemist, and as a basis for advanced work in specific fields.

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**Elements of Illuminating Engineering.** By A. P. Trotter. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. (Technical primers.) 103 pp., illus., 6 × 4 in., cloth, $0.85.

An introduction to the elements of the subject which gives a clear concise account of theoretical principles and of modern practice in distribution and measurement of illumination.

**Emission of Electricity from Hot Bodies.** By O. W. Richardson. Second edition. Lond. and N. Y., Longmans, Green and Co., 1921. (Monographs on physics.) 320 pp., 9 × 6 in., cloth, $5.25.

One of a series of monographs in physics edited by Sir J. J. Thomson and Professor Horton, revised and enlarged. Deals with emission of positive and negative electricity from hot bodies. The author was one of the first investigators of this subject. A clear, up-to-date account written by one who appreciates fully the experimental difficulties and the adequacy of the theories proposed.

**Essai Philosophique sur les Probabilités.** By Pierre-Simon Laplace. Paris, Gauthier-Villars et Cie, 1921. (Maîtres de la pensée scientifique.) 2 vol., 7 × 4 in., paper, 3 fr. per vol.

In this famous book Laplace presented, without resorting to analysis, the principles and general results of the theory of probabilities, and applied them to some of the most important questions of life. The present edition reproduces the best text in a cheap, convenient edition.

**Files and Filing.** By Ch. Fremont, translated under the supervision of George Taylor. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1920. 148 pp., illus., 11 × 9 in., cloth, $7.50.

A brief readable account of the origin and evolution of the file from the earliest times to modern days, the origin of file-cutting machines, methods of filing and influence of various factors on efficiency, the cut of files, their use and the methods of testing. The technical sections include the results of much scientific investigation in the author's laboratory. Will be interesting not only to makers and users of files, but to students of the history of machines. Fully illustrated.

**Fire Prevention and Fire Protection as Applied to Building Construction.** By Joseph Kendall Freitag. Second edition revised. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 1038 pp., illus., 7 × 4 in., fabrikoid, $5.

Extensively revised; changes in design, construction and equipment approved during the nine years that have elapsed since the first edition have been included.

**Food Products.** By E. H. S. Bailey. Second revised edition. Phila., P. Blakiston's Son & Co., 1921. 55 pp., illus., 8 × 5 in., cloth, $2.50.

Professor Bailey has collected the material distributed through a multitude of books and scientific reports upon the important foods and beverages of the world, their sources, methods of preparation for market, packing, preserving and shipping, composition, nutrient and dietetic value and their use.

**Graphical Analysis; a Text-book on Graphic Statics.** By William S. Wolfe. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 374 pp., illus., 9 × 6 in., cloth, $4.

Based on the author's courses in the University of Illinois. Deals with the analysis of stresses rather than with design or computation of loads, but includes some consideration of these questions also.

**Industrial Hydrogen.** By Hugh S. Taylor. N. Y., Chemical Catalog Co., Inc., 1921. (American Chemical Society. Monograph series.) 210 pp., illus., 9 × 6 in., cloth, $3.50.

Outlines the fundamental principles and essential chemical facts of the industry of hydrogen production, tracing the steps by which the present status has been reached, describing that status in detail and indicating probable future developments. While the chemical problems have been emphasized, the data needed by the engineer in plant design are also present.

**La Loi de Newton est La Loi Unique.** By Max Franck. Paris, Gauthier-Villars et Cie, 1921. 158 pp., 10 × 6 in., paper, 12.50 fr.

The question considered in this book is whether it is possible, with our present knowledge, to formulate the law governing the mechanism of the universe. Upon two postulates, that all potential energy resides in the absolute space of the physicist, and that all matter is formed of an element of inertia movable in space, the author erects a hypothesis, and compares its consequences with known facts, to determine how nearly the two agree. The first consequence is the confirmation of Newton's law which is the reason for the title. The author's theory uses only the notions of space, time, force and inertia admitted in Euclidean geometry and mechanics.

**Manual of Determinative Mineralogy.** By J. Volney Lewis Third revised and enlarged edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 298 pp., tables, 9 × 6 in., cloth, $3.

The blowpipe tables have been thoroughly revised and recast, and a new classification of minerals based on their physical properties has been added. The blowpipe tables include about 355 minerals and the physical classification about 290. The physical classification differs from common practice by eliminating luster as a basis of classification. The book is for the geologist and engineer, as well as for the student.

**Market Analysis.** By Percival White. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 340 pp., illus., 8 × 6 in., cloth. $3.50.

A guide for manufacturers, sales managers, engineers and others interested in the analysis and organization of markets. Gives instructions for conducting a market survey.

**Material Handling Cyclopedia.** Compiled and edited by Roy V Wright, John G. Little and Robert C. Augur. N. Y., Simmons-Boardman Publishing Co., 1921 846 pp., illus., 12 × 9 in., cloth, $10.

Definitions, descriptions, illustrations, applications and methods of operation of industrial devices for handling materials. Covers hoisting machinery, package conveyors, loose material conveyors, elevators, trackless transportation, industrial rail transportation and handling systems. Each section has been prepared by a specialist.

**Mémoires sur l'Électromagnétisme et l'Électrodynamique.** By André-Marie Ampère. 110 pp., illus., 7 × 4 in., paper, 3 fr.

In these two classic memoirs Ampère described his experiments upon the action exerted on an electric current by another current or a magnet; also the results of his study of the formula expressing the attraction and repulsion between two infinitely small elements of two conductors.

**Die Naturlichen und Kunstlichen Asphalte.** By J. Narcusson. Leipzig, Wilhelm, Engelmann. 262 pp., illus., 9 × 6 in., cloth, 34 M.

The first section discusses the occurrence, composition, properties and uses of asphalt, tars and pitches, and gives methods for their physical and chemical examination. Section two treats of asphalt products, sheet asphalt, asphalt cements, roofing papers, insulating materials, paints, etc., and pays special attention to methods for testing them. A list of the more important German, French and British patents is included. The book is based on investigations at the National Testing Laboratory. The methods of testing have given satisfaction during long use.

**La Physique Théorique Nouvelle.** By Julien Pacotte. Paris, Gauthier-Villars et Cie, 1921. 182 pp., 10 × 6 in., paper, 12 fr.

The new physics in question had its origin in Lorentz's electrodynamics, which is the definitive form of Maxwell's theory; its most advanced theories are due to Einstein; it has to do with relativity, with the energy equivalent of two masses of matter, with atoms of energy.

The author presents a historical, critical, non-mathematical account of the theories that underlie modern ideas.

**Practical Least Squares.** By Ora Miner Leland. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 237 pp., 9 × 6 in., cloth, $3.

A textbook based on the course given to students of civil engineering at Cornell University, designed particularly for short courses of instruction and for engineers and scientists in private practice. It will not replace more elaborate treatises, but the author hopes it will introduce the student directly to the simpler methods of solving the ordinary problems in adjustment.

**Public Opinion and the Steel Strike.** Supplementary reports of the investigators to the Commission of Inquiry, the Interchurch World Movement. N. Y., Harcourt, Brace and Co., 1921. 346 pp., 8 × 6 in., cloth, $2.50.

This volume contains over half the supplementary reports, published not only as supporting documents to the Report on the Steel Strike of 1919, but also as separate fuller studies of special phases of the investigation.

**Radio Questions and Answers.** By Arthur R. Nilson First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 86 pp., illus., 7 × 5 in., boards, $1.

A quiz compend for those preparing for examination. Treats of theory, apparatus, laws and regulations, etc.

**Radioactivity and Radioactive Substances.** By J. Chadwick. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. (Technical primers.) 111 pp., illus., 6 × 4 in., cloth, $0.85.

A simple, concise, accurate introduction to the subject of radioactive phenomena, by one with first-hand knowledge of the facts.

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**Railroads of Mexico.** By Fred Wilbur Powell. Boston, Stratford Co., 1921. 226 pp., 8 × 5 in., cloth, $2.

The author has endeavored to fill the lack of authentic information on the Mexican railroad situation by a study of the fragmentary data available. The first section of the book contains an account of transportation during the period following the Diaz régime and of the situation today. Part two is a summary of the development of the great Mexican system of land transportation. Part three presents the author's conclusions. An extensive bibliography is given.

**Taschenbuch für Bauingenieure.** By Max Foerster. Vierte auflage. Berlin, Julius Springer, 1921. 2 vol, illus., diagrs., tables, 8 × 5 in., cloth.

The field covered includes construction of public works, buildings, bridges, railroads and machinery. Prepared by specialists, under Dr. Foerster's guidance. Four editions within ten years.

**Treatise on the Integral Calculus.** By Joseph Edwards. Vol. 1. Lond., Macmillan and Co., Ltd., 1921. 907 pp., 9 × 6 in., cloth, $16. (Gift of The Macmillan Co., N. Y.)

The first volume of an extensive treatise for advanced students. Intended to give the reader a good working knowledge of integral calculus, practical and theoretical, as clearly as possible, with abundance of illustrative examples and instances of the application of the principles explained.

**Turbines.** By A. E. Tompkins. Third edition, revised. Lond., Society for Promoting Christian Knowledge; N. Y., The Macmillan Co., 1921. 180 pp., illus., 8 × 5 in., cloth, $2.50.

In simple, non-mathematical fashion, describes good modern practice in the construction and working arrangement of water turbines, turbine pumps and steam turbines. Useful to students and to men engaged in fitting and repairing turbines.

**Vorrichtungen im Maschinenbau Nebst Anwendungsbeispielen.** By Otto Lich. Berlin, Julius Springer, 1921. 507 pp., illus., diagrs., 9 × 6 in., cloth, 120 M.

A detailed study of clamps, fixtures and jigs for machine tools and of their application to increase output. All the customary operations, boring, slotting, planing, milling, forging, hardening, etc., are considered. There is also a section on the savings obtainable by such attachments and one on maintenance and repair. For machine builders, and for operators who wish to increase the efficiency of existing equipment. The author presents his book as a contribution to the reconstruction of the German metal industries, which he believes will be possible only through the greatest possible economy of time and labor.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau for one month.

Positions of the Bureau are on file in the offices of the member societies of the Federated American Engineering Societies and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Chemical Executive.**—Ten years in South America. Assistant manager large enterprise employing 800 men in mining, milling and maintenance. Fitted by experience and ability to handle native labor, and knowledge of customs and language for executive position in chemical or mining and milling capacity. IM–1526.

**Mechanical Engineer.**—Twenty years with leading copper and steel companies on maintenance and construction. Will consider chief draftsmanship at large plant. Just finishing 6-year foreign contract. States preferred. IM–1527.

**Manager or Superintendent.**—Technical graduate. Seventeen years in development and operation of mining properties. Ten years with one of largest companies in Mexico. Age 40. Married. IM–1528.

**Master Mechanic.**—Twenty years experience master mechanic on mines (both underground and steam-shovel mining), smelters, shops, foundry and locomotives. Married. Age 49. IM–1529.

**Mining and Mechanical Executive.**—University instructor or editorial engagement; North or West preferred. Technical (Lehigh University) graduate, 22 years practical experience engineering, managerial, vocational instructor and editorial work with large corporation. Age 44. Married, with family. IM–1530.

**Metallurgical Engineer.**—Capable and experienced in heat treatment and mechanical treatment of iron, steel, and non-ferrous alloys; also in conducting and directing research along these lines. IM–1531.

**Superintendent or Chief Engineer.**—Experience as chief draftsman, chief engineer and superintendent on construction and operation, smelters, electrolytic plants and general construction. Age 40. Married. IM–1532.

**Mining Engineer.**—Varied experience, particularly in copper and non-metallic industries. Prefers examination, report, or other technical position rather than strictly administrative or operating work. Somewhat familiar with Central and South America. Appointment in New York or other eastern locality. IM–1533.

**Geologist and Engineer.**—Experienced in geological explorations and detailed mine examinations in B. C. and Mexico. Speaks Spanish. IM–1534.

**Mine Manager or Superintendent.**—Twenty years experience, technical, practical and executive, principally metal mining. Some field and office work. Familiar milling and flotation. Foreign experience. Married. Available on short notice. IM–1535.

**Quarry and Open-cut Operator.**—Has made specialty of surface mining of large orebodies, big tonnages and low unit costs. College man, 39 years of age, married. Eight years experience in U. S. and seven in Mexico, in gold, silver-lead and copper properties, underground, surface operations, construction, efficiency and cost analysis. Engaged in Mexico but wishes to change. Fluent Spanish. IM–1536.

**Metallurgical Engineer.**—Harvard, M. I. T., graduate, 29 years of age, desires executive, technical, or sales connection. Experience: melter on Heroult electric furnace, making carbon and alloy steel castings; metallurgist and chemist for large steel plant; metallurgical engineer for carbon and high-speed steel tool manufacturing concern, in charge of chemical, metallurgical testing laboratories and heat treatment departments; metallurgical engineer for automobile drop forging manufacturing

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concern, in charge of metallurgical laboratory, heat treatment department, crucible steel and brass, bronze, aluminum foundry; works manager and secretary-treasurer of company manufacturing high-speed and other alloy steel tools by new process. IM–1537.

## Positions Open

**Transmission Line Superintendent.**—Must be conversant with practice in transmission lines, 100,000 volt, three-phase, 50-cycle. Capable of taking entire charge of transmission system of approximately 400 miles of line; familiar with construction and operating work, and capable of handling native help. Reply stating age, experience, training and salary desired. India. X–1292.

**Engineer** to take charge of an electrolytic silver refinery. Mass. X–1314.

**Expert Metallurgical Engineer** with experience in electrolytic partition of gold and silver. South America. X–1449.

**Salesmen.**—Two technical men who have had underground metal-mining experience, and who are between the ages of 25 and 35. Headquarters Butte, Mont. and Phoenix, Ariz. X–1475.

**Engineer** with practical converter experience in metallurgy of copper. Apply by letter stating age, education and experience. New Jersey. X–1529.

**Engineer** to sell preferred shares of public utilities. Must have had this experience. Single man 30 to 40 years old preferred. Willing to locate in small western cities for short periods. Apply by letter stating age, education and experience. X–1546.

**Expert Die-casting Engineer** for production work. Good personality and executive experience. Only men with die-casting experience considered. V–13.

**Search Assistants** educated in physics and electrical engineering. Recent graduates. East Pittsburgh. Apply by letter. V–33.

**Engineer** to assist in promoting drainage projects in places where they will accomplish a maximum reduction in the prevalence of malaria. Able to pass upon engineering features of drainage project and determine whether it would be feasible and advisable from a financial standpoint, whether it would eliminate malaria within the area, and to see that work would not increase malaria. So. Carolina. V–34.

**Engineer** to work with head chemist, principally on paints, oils and varnishes. Chemical engineer preferred. Mass. V–35.

**Fuel Engineer.**—Well acquainted with burning of cement, able to make determination on economical fuel consumption in kilns, etc. Apply by letter. Pennsylvania. V–41.

**Chemist.**—Technical education and actual experience, as assistant in laboratory of refinery. Indiana. V–64.

**Young Engineer** able to handle men and keep costs, with experience in mining and milling white clay. Temporary, but may be permanent for right man. South Carolina. V–80.

**First-class Operating and Manufacturing Engineer** to take charge of work of moving overburden, mining clay, and operating a drying and pulverizing plant. Eastern States. V–92.

# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

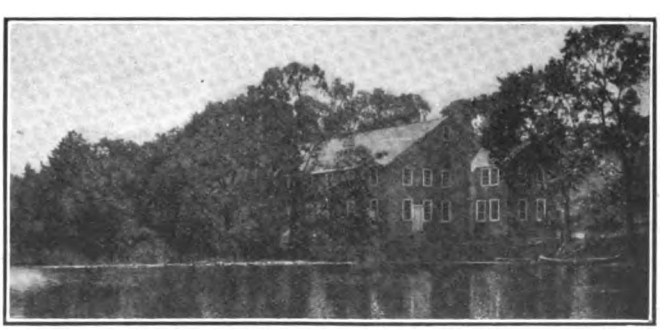
## Testing That Pays Dividends

THAT is the kind of testing for which the Westport Mill of the Dorr Company is intended. When a manufacturer is asked to replace an old and tried machine or method; when a banker or investor is urged to put his dollars behind a new product or a new process; one question instantly presents itself: "Will it pay?"

The idea of laboratories and testing plants in which to carry on the research needed to answer that question is not new, but the Westport Mill is unique in many respects. It is in the country, at Westport, Conn., not far from city conveniences, but far enough for a man to work and think without distraction and with all the inspiration that trees and brooks and good fresh air can bring.

The main building was originally a grist mill, but its interior now contains laboratories for organic and inorganic chemical work and a plant for tests of any process involving crushing, sampling, grinding, roasting, leaching, classification, dewatering, filtering or washing of coarse or finely divided solids. There is ample floor space for the installation of special machines, so that clients may, under certain conditions, conduct their own tests, and there are living quarters at the mill for transient visitors.

A problem submitted to the mill is considered from two aspects: Is it of such a nature that experience will enable the Dorr Company to handle it to the best advantage? Does its solution show genuine promise of profit to those interested in it? If the preliminary study is satisfactory, the problem is turned over to the director of the Westport Mill, with a full report of all conditions surrounding it.



THE WESTPORT MILL, CONTAINING LABORATORIES AND TESTING PLANT OF THE DORR COMPANY.

The mill and its work are described in a 16-page illustrated booklet just issued by the Dorr Company, under the title that heads this article. The company has offices at 101 Park Ave., New York City, in Denver, and in London, England.

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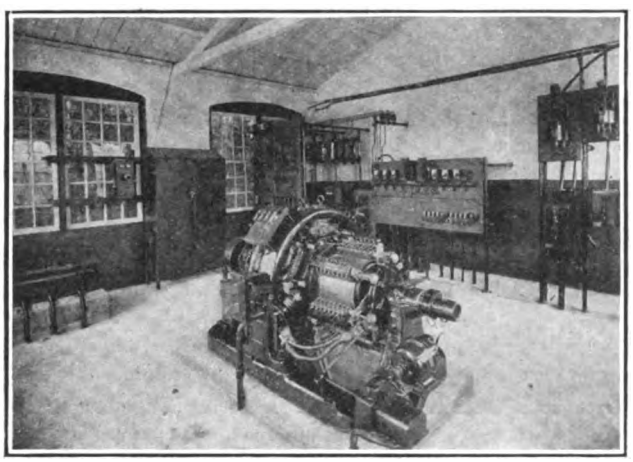
## Automatic Substation Demonstration

THE application of the automatic substation to coal-mining operations was demonstrated on Dec. 7 at the Drifton Colliery near Hazleton, Pa., under the joint auspices of the Lehigh Valley Coal Co. and the General Electric Co. The subject of the demonstration was a 200-kw. synchronous converter and automatic switching equipment operating from a 4600-volt incoming line, delivering direct current at 275 volts. This substation, which is in an isolated place, feeds the direct current to the mine through a bore hole and operates without attendance. It is actuated to start and stop by means of one small manually



INTERIOR VIEW OF AUTOMATIC SUBSTATION.

operated switch in an engine house about ½ mi. away, but all of the switching operations required for starting, stopping and protecting the equipment are automatic within the substation itself.

During the forenoon the purposes and the method of operation of the equipment and its parts were explained and the equipment was stopped and started. After the mine had loaded out, a further demonstration was made, in which abnormal conditions were produced or imitated, to illustrate the protection during emergencies and the automatic resumption of service when conditions return to normal.

Over sixty engineers and superintendents were present.

## Storage-battery Locomotive Approved

THE second official approval of a storage-battery locomotive for use in gaseous mines was issued by the United States Bureau of Mines to the Jeffrey Manufacturing Co., Columbus, Ohio. The approval covers a 6-ton storage-battery locomotive, which may be equipped with a battery consisting of either 80 Type-A-8 Edison cells or 48 Type M.V. 21 plate Iron-Clad Exide cells. Caustic potash is specified as the electrolyte for use with the Edison battery.

Each approved equipment will have an approval plate attached to the controller, bearing the seal of the Department of the Interior, Bureau of Mines, and including a caution statement which should aid both company and state inspectors in keeping the locomotives in a permissible condition.

## Industrial Notes

**W. S. Rockwell Co.**, New York, has appointed Gibbons Bros. Ltd., Dudley, Worc., England, its representative for the British Isles.

**D. T. Eastman,** having resigned as advertising manager of the Eagle-Picher Lead Co., Chicago, announces the organization of Eastman & Co., Technical Advertising, 63 E. Adams St., Chicago, Ill.

**C. G. Young Co., Inc.**, Consulting Engineers, has removed from 501 Fifth Ave., New York City, to the Bankers Trust Company Bldg. at 14 Wall St.

**Combustion Engineering Corpn.**, New York, has opened a branch office at 806 First National Bank Bldg., Pittsburgh, Pa. This office will be in charge of W. C. Stripe, formerly manager of the company's Philadelphia offices.

## Trade Catalogs

**Scovill Mfg. Co.**, Waterbury, Conn.—Tube Facts gives information about the Scovill company and the tubes it manufactures.

**Calorizing Company of Pittsburgh.**—Bulletin CT-1 on Calite castings for use in high temperature.

**Triplex Machine Tool Corpn.**, New York City.—Cat. No. 1, on Triplex No. 1 machine tool.

**Uehling Instrument Co.**, Paterson, N. J.—Bulletin 220, Magnitude of the Power Plant's Chimney Loss.

Bulletin 221, Relation Between $CO_2$ and Money Wasted up the Chimney.

**Pennsylvania Pump & Compressor Co.**, Easton, Pa.—Bulletin 102, on Pennsylvania single-stage, straight-line air compressors and vacuum pumps, both belt- and steam-driven types. This describes the special features, such as plate valves with inlet and discharge valve assembly interchangeable, removable phosphor-bronze main bearings, aluminum oil guard, etc.

**F. Davidson & Co.**, 26 Gt. Portland St., London.—Bulletin describing the Davon Micro-Telescope and Super-Microscope and the various developments thereof. The former is a combination of microscope and telescope, doing the work of both instruments and filling the gap between them. The Super-microscope provides increased depth of focus in the microscope both for visual observations and photomicrography.

The critical image having been obtained, the Super-microscope offers the following advantages in high power microscopy: (1) An increase of nearly 100 per cent. in the magnification usually given by a ⅙-in. objective, enabling it, if of high N. A., to be used for most purposes for which the 1/12-in. oil immersion objective is now used. (2) An increase of 50 per cent. at least on the magnification usually given by a 1/12-in. (3) Variable magnification: from 600 to 1100 with ⅙-in., or to 1500 with 1/12-in. without loss of resolution. These results have been obtained on achromatic objectives, and without either an achromatic condenser or color filter. Using an achromatic condenser and color filter, magnification up to a limit of 1350 can be effectively employed with a ⅙-in. With higher grade objectives such as the semi-apochromatic or fluorite, still better results may be obtained.

**Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.**—

Reprint 104: Babbitting Motor Bearings
Reprint 106: Westinghouse Marine Equipment
I. B. 5220: Westinghouse Small Geared Turbines
I. B. 5212: Westinghouse Turbines for Mechanical Drive
Leaflet 1213: Type CW Wound-rotor Induction Motors
Leaflet 3432: Westinghouse Diesel Electric Propulsion
Leaflet 3434: The Twin Six Rectigon for Large Service Stations
Leaflet 3441: Automatic Substations for Mine Service
Leaflet 3769: Typical Performance Curves of Type
Leaflet -A OA. Watthour Meters
Leaflet 3894: Unit Type Surface Condensers

Sets of these Westinghouse publications are available for engineering laboratories, computing rooms and libraries upon request.

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# MINING AND METALLURGY

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# MINING AND METALLURGY

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No. 183 MARCH 1922


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## EDITORIAL

### Plea for Conservation of Helium Gas*

THE importance of helium gas, either for national defense or for future use in commercial aerial transportation, is due to its non-inflammable, non-explosive, and inert qualities. It has a lifting power equal to 92 per cent. of that of hydrogen. The cost of its segregation from the natural gases in which it occurs has been reduced from the pre-war figure of $1700 per single cubic foot to less than one ten-thousandth of that figure and a further great reduction is expected.

The recent successful flight of the first helium-filled lighter than air dirigible of the Navy, the C-7, from Norfolk to and around Washington and return, has demonstrated not only the added safety in the flight of such a helium-filled ship, but also remarkable operating advantages. When the time comes for passengers to take passage in a helium-filled airship from New York to San Francisco, for example, safety will be a most important factor and non-inflammable and non-explosive helium instead of hydrogen will be a requirement for such airships.

The United States is the only country whose natural resources, so far as is known, include helium in commercial quantities. The immediate sources available are certain natural gases occurring almost entirely in the United States. But there will be no earnest exploitation of helium unless a speedy and extensive conservation program be carried through either by the government or by financially strong commercial agencies. At the present time it is estimated that there is going to waste annually, through the unconserved and ungoverned use of natural gas in various states, a volume of helium equal to 400,000,000 cu. ft., with a force expressed as balancing power equal to 25,000,000 lb. The program which combines the two problems of conservation and storage, by leaving the gas under ground, is a practical one. This program implies the production of a working amount of helium only.



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It is not safe to infer that there is ample time for conservation of helium because the natural gas supply is abundant. Helium is found in small percentages in natural gases widely disseminated over the country, it is true, but there are only certain fields in which the percentage is sufficiently high to warrant economical production. Underground conservation, along the same lines adopted by Nature through all the years before science had come to know of the existence of this new and valuable gas, must be restored pending that date when studies now under way succeed in applying the principles of thermo-dynamics and mechanics to the large-scale low-cost production of this gas.

Immediate conservation of the fast diminishing supply is necessary. The supply is all too limited at best. Once gone it cannot be replaced, and the United States is the only country known to contain helium in amounts warranting attempts at commercial exploitation. Enough has been produced to permit aeronautic experimentation to begin, and enough work done to point the way to cheap production.

H. S. MULLIKEN.

This was sent to the printer before the recent disaster to the U. S. dirigible "Roma" at Langley Field.—EDITOR.

## Economic Forecasts

FORECASTS are always uncertain things, but they are made, and have to be made. As soon as mankind emerged from the state of barbarism the direction of affairs passed into the hands of men who were able by their intelligence and reasoning powers to forecast coming events. At the present time every man of business and every engineer is bound to forecast something or other in the course of his daily work. In the highest rank of importance in the determination of the courses of nations and industries is the forecasting of broad economic developments. After they have happened and we look back upon them we see that they were inevitable. But in looking forward the vision is always obscured by mists of the unknown. This is why there are generally differences in opinion.

At present, the most vital concern of the American people, of the people of the whole world, is what is going to happen in 1922. Perhaps there was never a time when forecasts were so widely different. They are as far apart as the north and south poles. It will serve a useful purpose to summarize these opinions and explain the reasons for the differences between them.

According to one opinion, the United States has passed through the worst of the economic readjustment following the war and is now industrially moving upward, with prospect of the early advent of a period of unparalleled industrial prosperity, the arrival of which is expected early in 1922.

According to the other opinion, the United States has passed through only the first stage of the economic readjustment, the consummation of which is still far distant, with the prospect that 1922 will be a year of great trouble.

Popularly, the first is the majority opinion, and the second the minority. There are, of course, intermediate opinions, but they are the expression of conservativeness rather than reflections of fundamental thought.

The bases for the first opinion are these:

1. A theory of business cycles, evincing the idea that business in the aggregate moves in undulations during more or less regular periods and that it is now about time for an upward movement.

2. The unquestionable evidence of a certain increase in the physical volume of business, beginning with the fourth quarter of 1921, or thereabouts.

3. The theory that there will be a secondary period of inflation, as a consequence of the quantity of gold now in the possession of this country and the ability to expand credit upon this basis.

The first of these reasons may be dismissed as unworthy of serious attention. The idea of ups and downs in business is clearly founded upon facts, but that there is any natural law as to regular periodicity is irrational.

The second reason for expecting an early return of prosperity is considerably associated with the first. Because of the thought that the time has arrived for a periodic change, the fact that there has been a certain improvement is accepted as evidence in proof of the theory. This is, however, something on the order of estimating the future earnings of a mine from the records of the past, without taking into consideration the probable conditions in the future.

We can find adequate explanations for the improvement in physical volume of business since Oct. 1, without any self-deception as to what it may mean. Undoubtedly the people of the country have been conducting their affairs for a long time with a subnormal and diminishing stock of goods. The time was bound to come when excessive depletion in certain lines would necessitate a replenishing, just as the individual merchant is constantly obliged to make in evening up. Secondly, there has been some increase in the volume of building, for which there is urgent need, that has been undertaken by some people who have come to the conclusion that even now costs are relatively cheap. Such persons may be right if the third reason for expecting early activity, *viz.*, renewed inflation, is sound.

The bases for the second, or minority, opinion are these:

1. The impoverishment of the world in property and man power.

2. The staggering indebtedness of the nations, external and internal.

3. The chaos in the currencies of Europe.

4. The destruction of all principles of authority, outside of a few countries.

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5. The unbalance of economic conditions everywhere, including the United States.

These are bold outlines of grave subjects, each of which is big enough for a book. Three years after the armistice scarcely any progress has been made in the readjustment of any of them. It is unforeseen how prosperity can grow in any country in the face of them.

The economists who entertain the second opinion do not consider that in countries like the United States which remained on a gold basis the high prices of 1916–20 were due to currency inflation, but rather were they ascribable to conditions of demand and supply. Expansion in the volume of currency followed the need for it and contraction conformed to the decline in requirements. This is the pronouncement of the Federal Reserve Board.

If, then, there were no currency inflation in 1916–20 there is no reason to expect a secondary inflation in 1922. Money is steadily being released, to be sure, by the liquidation of loans on commodities which are gradually being consumed; and being so released it seeks investment, which is reflected in the rising prices for bonds. It is in prospect that the interest rate will fall to a low point, but it does not necessarily follow from this that money will seek investment immediately in new enterprises. Probably it will not until the readjustment of prices for commodities and wages for labor has become complete, or nearly so.

When that stage has been reached there must necessarily be extensive industrial activity in the United States for the replenishment of depleted stocks of goods and in the building that is required to make good the deficiency in our housing capacity and transportation facilities. This may be regarded as certain, for the need exists and there will be the means after some corrections in our affairs have been made.

The holders of the first opinion, *viz.*, a secondary inflation with its illusory activity, look for a serious collapse later on; at least the more far-sighted of them do. It comes, therefore, to this: One view contemplates early activity followed by depression, while the other sees a prospect of continued depression and readjustment, followed by activity. I think this is a fair statement of the two opposite forecasts and the reasons upon which they are based.

While the general trend of events appears to be probable in one of these directions, so far as can be discerned now, there are likely to be occurrences that will cause complete upsets of any forecast. This is one of the contingencies that endangers forecasting. There are possibilities of this nature that we can imagine; for example, war in Ireland, the declaration of bankruptcy by Germany, the granting of a soldiers' bonus in the United States. Events of that nature may switch world economic affairs upon a new track, without however altering the fundamentals.

W. R. INGALLS.

## Legal and Academic Definitions of Engineering

WHEN Engineering Council's Committee on Licensing of Engineers early in 1919 began its task of framing a model bill for the purpose of licensing, it seemed desirable to include a definition of engineer and engineering. Many attempts at such definition were made by the committee and A. D. Flinn, secretary of the Council, aided by eminent legal and engineering talent, with the resources of the largest technical library in the world at hand. The result was a 22-page typewritten report of the greatest interest which did not, however, define either word. Not the least interesting part of this report states:

> Many definitions of engineer and engineering were found in dictionaries, encyclopaedias and engineering literature. None proved adequate for the purposes of a statute, for none was found sufficiently comprehensive for the modern profession of engineering which did not also include architecture and possibly other professions of the applied sciences. The Committee on Licensing of Engineers concluded that it was impracticable to write a definition suited to its purposes.

The first New York license law, which was passed in May, 1920, did not contain a definition and the attorney-general of the state ruled that the Board of Education could not license anything it did not define and therefore an amendment must be drawn containing a definition. This definition was drawn by a prominent civil engineer and was predicated on the use of the terms by the Institution of Civil Engineers in England and it was felt that, having more than 100 years usage to support it, it would stand the test of the requirements should it ever be tested in court.

However, the attorney general pronounced it unworkable and said that under it a football coach or the director of a rowing crew could take out a license as a professional engineer because he was directing the forces of nature for human welfare or the public good.

The Engineering Council's illuminating report on this subject tells of the great difficulties of preparing a definition to embrace all branches of engineering and not include other professions or other men who "by an unfortunate duality in the English vocabulary are also called engineers," like engine drivers, motormen, etc. This report of Engineering Council listed 57 different varieties of professional engineers as distinguished from vocational engineers.

In the difficult search for an all embracing definition, Gano Dunn, then president of the A. I. E. E., seeking for that which might be expected to be common to all kinds of engineers, said, "A light is shed if we examine the popular definition that engineering is 'educated common sense.' Can it be that unlike physician, lawyer, teacher, the term engineer does not describe what a man does, but rather how he does it? A method rather than an occupation? It is even so; that is, essentially and with limitations." In summing up his investigations and his arguments he concluded that the profession of engineering, while it may be an occupation "also is a way of thinking and as such is not an occupation but the latest and most highly devel-

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oped scientific method of solving all kinds of practical problems of matter and force for the benefit of the human race."

It seems evident that no academic definition of engineering has yet been found which is a good working legal definition, and it is equally evident that no legal definition yet produced even approaches satisfaction to the engineering profession.

PERCY E. BARBOUR.

## National Mine Safety Movement

IT SEEMS to a prejudiced observer like myself that the achievements of the Mining Section of the National Safety Council in the past have been so solid that it deserves the strongest support the mining industry can give to this movement. Also, the possibilities of great benefit accruing to the various members of the Institute, providing they personally and directly contribute to this field of endeavor, warrant their urgent solicitation for an active participation in the safety movement through this body.

It is my impression that very few mining executives of the rank of superintendent or higher have taken the trouble to become so vitally interested in the safety movement as to participate actively in the detail direction of such a movement in their plant or to take up actively such work in any national safety organization which might deal with their problem. If so, this is a great mistake on their part, for safety and efficiency are so closely correlated as to be inseparable. The most efficient method should be the safest practical method; and vice versa, the safest practical method should be the most efficient method. The very fact that increased efficiency reduces the number of units of labor required per unit of production is in itself a reduction of hazard; also, when a workman becomes so trained in the practice of safe methods and his fellow workmen are also careful in the same degree, there is little distracting effort on their part to protect themselves from unknown hazards, and the result is a closer attention to their work and a considerable increase in efficiency.

My visions and hopes for the future of this movement are that 3000 or 4000, instead of 300 or 400 as at present, will participate in furthering this work; that local sections may be organized in the various mining camps and mining centers of the country; and in the third place, it is my hope that the members of the American Institute of Mining and Metallurgical Engineers may be drawn into joint meetings with the Mining Section of the National Safety Council and that it will be possible, therefore, to get the direct attention of a great many mining executives who have so far delegated the consideration of the practical phases of accident prevention work to the safety engineers in their organizations without having themselves clearly recognized the various details that arise.

The safety movement needs the direct contact of such men in the puzzling questions which continually arise in this field of work. These men also need contact with the foremen and shift bosses and safety engineers upon whom the success of this work has largely depended and it is to be hoped that in the joint meetings of the A. I. M. E. there may be brought about a freedom of discussion representative not only of the executive group but of the working and supervisory group of the mining industry. There has been some success in these lines in the meetings of the Mining Section of the National Safety Council and I consider that it has performed a very real benefit to the industry in furnishing a place where foremen and shift bosses, and sometimes miners, have been led to discuss their own intimate problems in the presence of some executives. It seems to me that the Institute very greatly needs this contact of the man nearest in responsibility to the productivity of labor with the executive in discussion of their mutual problems, both, as they refer to the safety movement and also as they touch upon the other interests of the A. I. M. E.

B. F. TILLSON.

## Patient Office Relief Bill Passed

WITHOUT a dissenting vote the Patent Office Relief Bill, after having passed the House, was passed by the Senate and has been signed by the President. This is the culmination of three years persistent and energetic effort on the part of engineers to accomplish this much desired result which is in no way class legislation but is pre-eminently for the good of the entire community. It is an example of the good that can result from engineer participation in other than technical endeavors.

PERCY E. BARBOUR.

## Topographic Appropriation Cut

THE House Appropriations Committee reported the Department of the Interior bill cutting the budget recommendation of $425,000 for topographic mapping work to $275,000. The House voted down an amendment of Representative Hayden of Arizona to increase this appropriation to the budget recommendation of $425,000. Engineers are vitally interested in this item and they hope to convince the Senate Committee that an appropriation of at least $425,000 should be made. Should this topographic mapping work be curtailed to the extent necessary under an appropriation of only $275,000, it would so cripple the state coöperative work and the topographic mapping branch of the Geological Survey that completion of the work would not be in time to benefit the present generation.

PERCY E. BARBOUR.

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# Review of the Month

THE great subject of interest in American affairs during February was the consideration of the proposed soldier bonus. This proposal was based upon the idea that, because most of the workers of the United States had enjoyed high wages during war, the soldiers were entitled to "adjusted compensation" in order to equalize things. It overlooked the fact that the soldiers, themselves, had the opportunity to enjoy high wages in 1919 and 1920, when rates were highest. Apart from this, the whole project was founded on fallacies and involved what would be nothing less than economic crime. Although it looked as if the measure were destined to be railroaded through Congress, so great a storm of protest was pelted upon Congress that the present outlook is that the whole project will be abandoned.

There was probably some increase in the physical volume of business during February. A rise in prices for agricultural products assisted the farmers materially. These developments, however, are not to be construed as presaging any general upward movement.

On the contrary, the current year is to be contemplated as one of serious labor troubles, following inevitable reductions of wages. These began in February in the form of an extensive strike in the cotton textile industry of New England, accompanied by some rioting in Rhode Island. The coal miners have had numerous conferences, without coming to any encouraging results, and the stage appears to be fully set for a general strike beginning Apr. 1. About the only question now is whether this will comprise both the bituminous and anthracite miners. If the latter refuse to go out, no serious shortage of coal is anticipated, the belief being that the existing stocks together with the output of the non-union mines will supply the demand, which is sub-normal even now.

In the metal industries, lead and zinc were dull but stable. The weakening tendency in iron and steel that was manifest during January appeared to be checked, at least temporarily. Copper was characterized by a distinct weakness and a considerable decline in the market. This downward movement was inspired by the news during January that several of the important mining companies were taking steps to resume production. During February the demand for copper, both foreign and domestic, was poor.

As the result of the negotiation whereby the Anaconda Copper Mining Co. was to secure the controlling interest in the American Brass Co., partly for cash and partly for exchange of stock, upward of 149,800 shares of the 150,000 shares of the American Brass Co. were turned into Anaconda. The latter became therefore practically the sole owner of the American Brass Co. and perfected a fully integrated business, so as to carry its own copper all the way from the mines to the fabricated products.

In foreign affairs, the Germans carried out the Cannes agreement, making reparation payments at 10-day intervals. There was a postponement of the Genoa Conference, pending further preliminary negotiations among the powers that are likely to participate. A good deal appears to hinge upon the position of Russia, which economically can no longer be ignored, no matter how much dislike there may be for its present form of government.

The President of the United States appointed a commission comprising Messrs. Hughes, Hoover, Mellon, Smoot and Burton to make arrangements for funding the debt of the European governments to us. Fundamental economic problems will be involved in these considerations.

M. Loucheur, of the French Government, made a statement to the effect that France would be unable to pay its foreign debts, either now or at any time.

The strike of the miners on the Witwatersrand continued, all efforts to effect a settlement proving unavailing. Cable dispatches from Johannesburg, toward the end of February, reported that most of the gold mines were then working on a limited scale and more men were returning daily. If adequate police protection is provided, and this the Government has promised, it was believed the strike would shortly come to an end.

Labor troubles are to be expected anywhere and everywhere this year, for labor does not understand the controlling economic factors and even in the countries of best position the people are approaching the end of their ability to live on their fat. In most of the countries of Europe large percentages of the workers are unemployed, and of course there can be no prosperity when many workers are idle. Of all countries Germany is the most active, but even there productivity is far below pre-war level. Germany's national income in 1913 was estimated at 42 billion gold marks. For 1921, estimates range from 14 to 18 billion. Although the latter figures look rather doubtful, they assist in a visualization of the economic situation in Germany. Railway traffic in Germany, which in 1920 was only 65 per cent. of pre-war volume, had recovered to only 80 per cent. in 1921. It is becoming recognized even by socialists that people *en masse* working only 8 hr. per day, as prescribed by the League of Nations, cannot produce enough to afford them a scale of living as high as they had before the war. But obviously, many groups of workers will strike in resistance to the inexorable and non-understandable.

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ANNUAL BANQUET OF THE A. I. M. E. AT THE HOTEL PENNSYLVANIA, FEB. 23, 1922.

AT THE GUEST TABLE: H. S. MULLIKEN GEORGE F. KUNZ, H. FOSTER BAIN, ARTHUR S. DWIGHT, GEORGE OTIS SMITH, EDWIN LUDLOW, WILLIAM MCCLELLAN, L. K. ARMSTRONG, ALFRED W. G. WILSON, PHILIP N. MOORE.

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# The 125th Meeting of the Institute

THE 125th meeting of the Institute was held in New York, Feb. 20–23, 1922, inclusive, and was the most successful annual meeting of the Institute ever held; there was a larger registration, there were more sessions of importance, and a greater number of sessions, than in any previous year. The total registration was 1331, comprising 351 New York members, 393 visiting members and 587 guests.

At the annual business meeting of the Institute, held on Tuesday, Feb. 21, with President Ludlow presiding, there was a much larger attendance than usual. The report of the tellers was read and the following officers were declared elected:

Arthur S. Dwight, *Director and President*—District 0
J. V. W. Reynders, *Director and Vice-president*—District 0
A. R. Ledoux, *Director and Vice-president*—District 0
Charles F. Rand, *Director*—District 0
George D. Barron, *Director*—District 0
William H. Bassett, *Director*—District 1
Thomas B. Stearns, *Director*—District 8
William Kelly, *Director*—District 5

These new officers, with those who are continued in office, form the complete Board for 1922. The latter are:

VICE-PRESIDENTS

Frederick Laist—District 7
Seeley W. Mudd—District 10
E. L. DeGolyer—District 0
Albert Burch—District 10

DIRECTORS

William M. Corse—District 1
W. H. Aldridge—District 0
R. M. Catlin—District 1
G. H. Clevenger—District 1
E. P. Mathewson—District 0
R. V. Norris—District 2
W. G. Mather—District 3
George Otis Smith—District 4
W. E. Wrather—District 6
J. C. Greenway—District 9

At the Directors' meeting that followed, J. V. W. Reynders was elected First Vice-president, and C. F. Rand was made Treasurer.

Section III of Article 6 of the Constitution was amended by changing the word "six" to the word "eight," requiring eight for a quorum of the Board of Directors necessary to transact business. There were 1681 votes cast in favor of this amendment, 272 votes were cast against it, and 90 votes were marked in such a way as to be declared void by the tellers. Reports of the Secretary; the Treasurer; the Membership committee, showing a gain in membership for the year from 9323 to 10,205 as of Dec. 31, 1921; the Library committee and the Papers of Publications committee, were read and have been published. The President announced that he would incorporate his report in his speech at the banquet.

TECHNICAL SESSIONS

The technical sessions were greater in number than ever before and overflowed the ordinary space at the service of the Institute for this purpose; several sessions were held in the quarters of the other societies, which gladly donated rooms for this purpose.

The Symposium on Foreign Oil Possibilities and Details of the Oil Industry drew the largest attendance and occupied the center of interest. The oil sessions overflowed their quarters on the first day and had to be transferred to the Auditorium. Only the papers presented at the last oil session had been prepared for advance distribution, because the discussion at the earlier sessions, in many cases, dealt with the delicate situation of international policy, and for the same reason none of these sessions was reported, as were all of the other sessions. Some of the papers may be published later.

SCENE AT THE REGISTRATION DESK DURING A LULL.

The Mining Methods Committee, engaged as it is in the monumental work of collecting data from all of the

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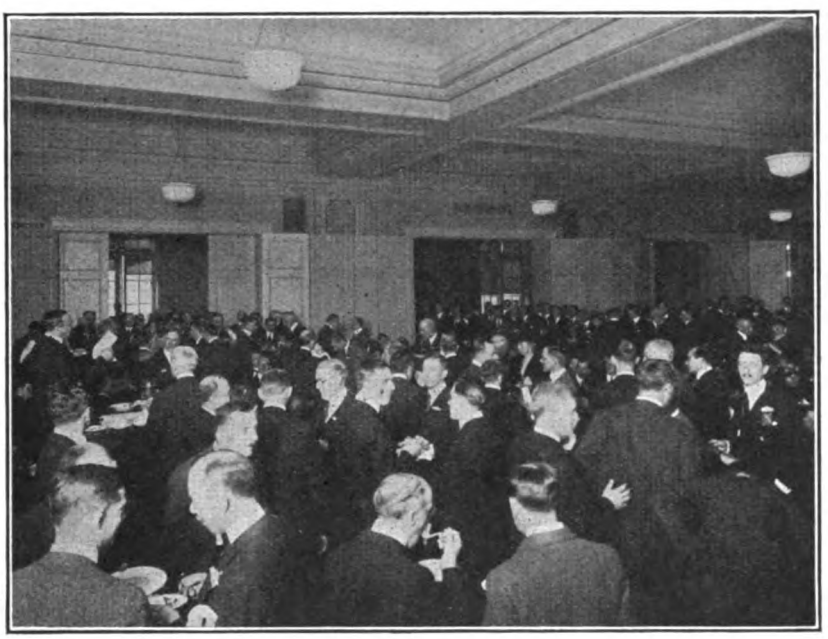
big mines of the United States to answer the questions involved in the choice of mining methods with all the necessary controlling factors, had a continuous session of well-attended meetings throughout the convention.

The Institute of Metals Division, in addition to two of the largest sessions it has held since affiliating with the Institute, conducted the lecture by Prof. Wilder D. Bancroft on Colloid Chemistry and Metallurgy, which attracted a great deal of interest. This lecture was not prepared as a paper, but may be presented in this form later.

The Iron and Steel Sessions were in part devoted to memorials of the late Prof. J. W. Richards, who was for so long its very able and efficient chairman.

The Safety Sessions were joint sessions of the Mining Section of the National Safety Council and the Industrial Relations Committee of the Institute, and another notable joint session was a meeting of the Mining and Metallurgical Society of America with the Institute, at which papers and discussions on Waste in the Mining Industry were presented. These constitute the feature of this March number.



CHAIRMAN OF THE NEW YORK SECTION HOLDING UP THE LUNCHEON TO MAKE AN ANNOUNCEMENT.

In opening this session, Allen H. Rogers, president of the Mining and Metallurgical Society, said:

It is the usual thing to speak of an event like the present as an auspicious occasion. I really feel that it is quite an auspicious occasion because it is the first time that the Institute authorities have asked the Mining and Metallurgical Society to join with them.

The Mining and Metallurgical Society, as you all know, was founded about fourteen years ago, and at the time there was a good deal of opposition to it among certain of the members of the Institute. It was felt that the Society was founded as an opposition organization; that it was founded to do the Institute harm. This has not been the case, as you all know. Those of us who are members of the Mining and Metallurgical Society (and we all, with very few exceptions are members of the Institute) know that the Society has always been very particular to avoid encroaching on the field of the Institute. The Society has felt its function to be the discussion of what we may speak of as "extra-technical" subjects, subjects having to do with policy, particularly of the mining industry as a whole.

With that thought, the aim has been to keep the membership of the Society to men of a good deal of age and experience. The younger men as they grow old naturally acquire the experience which enables them to become eligible to membership in the Society and even though the Institute has, since those early days, raised its requirements for membership, the Society still represents, in the main, men of long experience in the industry.

As illustrative of the class of subjects that the Society discusses, we have selected for the subject of discussion today "Waste in the Mining Industry." The discussion of this subject unquestionably involves a certain technical practice, but in the main, it is a broad subject, covering the industry as a whole and as such comes within the purview of the Society itself.

In approaching a subject, it is natural to take it up in its logical order and as we know, in the mining industry, the first thing to do in the case of a mineral deposit is to discover and develop it. This viewpoint of the subject, that is, as the paper was entitled, "Waste Involved in Preliminary Investigation of Mineral Deposits," was to have been treated by Mr. J. E. Spurr. He has unfortunately been called to the West and so cannot be present. We are fortunate, however, in having gained the consent of Mr. H. Foster Bain to say a few words on this subject. (See page 23.)

The next step in the industry, after having discovered the deposit and developed it, is naturally the management of it, the exploitation. We have with us today a man who stands preeminent in that branch of the field. The Mining and Metallurgical Society conferred upon him its gold medal for his proficiency in management. It will be instructive, therefore to all, and a great pleasure, to hear from Mr. Pope Yeatman regarding Factors in the Management of Mining Properties which Lead to Loss and Waste. (See page 25.)

There is another element causing waste in the mining industry and that is an economic one—one having to do with efficiency, perhaps more particularly of labor; and we have with us Mr. W. R. Ingalls, who is very competent to treat of that branch of the subject. He has been two or three times the president of the Mining and Metallurgical Society. He is a mining engineer and a metallurgist who specializes more particularly in zinc metallurgy, and recently he has gotten a national prominence as an economist. Mr. Ingalls will present his paper on Elimination of Waste and the Improvement of Efficiency. What are the Economic Fundamentals? (See page 33.)

The relation of waste to the anthracite and bituminous coal industries will be discussed by Mr. Edwin Ludlow, the retiring president of the Institute, who has been a large operator in both hard and soft coal; and, lastly, Mr. J. Parke Channing, chairman of the committee on waste in industry of the Federated American Engineering Societies, will review the subject and the work of the committee. (See pages 39 and 41.)

Another innovation at this meeting was a Local Section Convention, at which the chairmen and secretaries of the various local sections, or in their absence their representatives, gathered to discuss local section problems as related to the Institute and its problems as related to the local sections. The new

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president of the Institute, Col. Arthur S. Dwight, presided. This convention proved to be such an interesting feature that the one session provided for its initial meeting was entirely inadequate, and it is hoped and expected that it will become a permanent feature of the Institute meetings.

Heretofore, the Iron and Steel Committee and the Executive Committee of the Institute of Metals Division have held the only Committee dinners but this year the Petroleum and Gas Committee, the Industrial Relations Committee, the Mining Methods Committee, and the Milling Methods Committee also met at dinner or luncheon. These gatherings proved so interesting and inspiring that it is expected that they will be continued and that the number of committees to hold such functions will be increased.

The Industrial Relations Committee and the Non-Metallic Committee had interesting technical sessions. The Institute Committee on Ground Movement and Subsidence, and the Committee on Breakage and Heat Treatment of Drill Steel, appointed last year as an advisory committee to the Bureau of Mines, held meetings on Monday morning. The last-named committee has been made permanent and has been promised support by the Bureau of Mines for a special investigation. Technical sessions were as follows:

**Symposium on Foreign Oil Possibilities and Details of the Oil Industry**

Chairman, Ralph Arnold

TUESDAY MORNING, FEB. 21

Introductory Remarks. Ralph Arnold.
Addresses on: Oil Reserves of United States. David White.
Canada. Ralph Arnold and Walter A. English.
Mexico. V. R. Garfias.
Trinidad. Ralph Arnold.
West Indies, except Trinidad. A. H. Redfield.
Central America. A. H. Redfield.
Colombia. Chester W. Washburne and K. D. White.
Venezuela and the Guianas. Ralph Arnold and B. Bryan.

TUESDAY AFTERNOON

Addresses on: Oil Reserves of Peru and Ecuador. V. F. Marsters.
Bolivia. C. W. Washburne.
Argentine and Chile. E. W. Shaw.
Brazil. J. C. Branner.
Japan. J. Morgan Clements.
China and Siberia. Eliot Blackwelder.
Philippines. W. E. Pratt.
Galicia. R. N. Ferguson.
Europe, Africa, Asia, Australia, New Zealand, and East Indies. A. Beeby Thompson and Robert Anderson.

WEDNESDAY MORNING, FEB. 22

Addresses on: Suggestions for Stabilizing the Oil Industry. Henry L. Doherty.
Oil Laws of Latin-American Countries. Edward Schuster and Frank Feuille.
What the State Department Can do to Aid in Foreign Oil Development. Lester H. Woolsey.

WEDNESDAY AFTERNOON

Future Demands on Oil Industry of United States. By J. E. Pogue.
Time to Pay out as a Basis for Valuation of Oil Properties. By W. Irwin Moyer.
Production Problems of Grass Creek Oil Fields. By E. L. Estabrook.
Possible Origin of Oil. By Colin C. Rae.
Subsurface Conditions on Portion of Arches Fork Anticline. By K. Cottingham.

**Mining Sessions**

MONDAY AFTERNOON, FEB. 20

Chairman, B. B. Gottsberger

Sampling and Estimating Ore Deposits. Introductory Remarks by B. B. Gottsberger.
Diamond-drill Sampling Methods. By R. D. Longyear.
Sampling and Estimating Disseminated Copper Deposits. By I. B. Joralemon.
Sampling and Estimating Iron-ore Deposits:
Lake Superior Iron District. By J. F. Wolff, E. L. Derby, and W. A. Cole.
Gogebic Range. By J. F. Wolff.
Menominee Range. By J. F. Wolff.
Marquette Range. By R. W. Bowers.
Sampling and Estimating Zinc and Lead Orebodies of Mississippi Valley. By W. F. Boericke.
Organization of Mine Sampling at Anaconda. By W. B. Daly and F. A. Linforth.

TUESDAY MORNING, FEB. 21

Chairman, William Kelly

Storage-battery Locomotive as Applied to Mine Haulage. By Charles E. Stuart.
Electric Haulage Systems in Butte Mines. By C. D. Woodward.
Handling Ore in Mines of Butte District. By H. R. Tunnell.
Power Distributing System for Deep Metal Mines. By C. D. Woodward.
Effect of Rate of Production on Profits. By W. O. Hotchkiss.

TUESDAY AFTERNOON

Chairman, E. E. Hunner

Introductory Remarks on Work of Mining Methods Committee. By John E. Hodge.
Mining Engineers. By Arthur Thacher.
Recovery of Tonnages and Values under Various Mining Methods. By Henry Krumb.
Nomenclature of Mining Methods. By F. W. Sperr.
General Outlines for Obtaining Data. By E. E. Hunner.
Discussion by Messrs. Charlton, Gillies, Hotchkiss, Jackson, Kelly, Kemp, Linton, Raymond, Sebenius, Stoek, Westervelt, Yeatman.
Spies Open-stope System of Mining. By S. R. Elliott.
Stope Cost Records and Mine Contracts of A. C. M. Co. By C. I. Berrien.
Steam-shovel Operations at Bisbee, Ariz. By H. M. Ziesemer and George Mieyr.
Mining Methods at the Ashio Copper Mine. By M. Otagawa.

WEDNESDAY MORNING, FEB. 22

Chairman, Howard N. Eavenson

Systems of Mining in Pocahontas Coal Field, and Recoveries from Them. By T. H. Clagett.
Discussion by Messrs. Gay, Haas, Peltier, Ramsay, Cox, and Newbaker.
Can Anthracite Mines be Operated Profitably on More than One Shift? By D. C. Ashmead.
Some Considerations Affecting the Extraction of Bituminous Coal in American Mines. By H. H. Stoek.

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*Mine Timber Preservation. By R. R. Horner and G. M. Hunt.
Underground Fire-Prevention by the Anaconda Copper Mining Co. By E. M. Norris.
Mine Fires and Hydraulic Filling. By H. J. Rahilly.

**Safety Session—Wire Ropes and Hoisting†**

MONDAY AFTERNOON, FEB. 20

Joint Chairmen, B. F. Tillson and H. F. Lunt

Safety Practice for Hoisting Ropes. By R. M. Raymond.
Use of Wire Rope in Mining Operations. By J. F. Howe.
Wire Rope and Safety in Hoisting at Butte Mines. By W. N. Tanner and F. C. Jaccard.
Safety Devices for Mine Shafts. By Rudolf Kudlich.

**Safety Session—Ventilation†**

TUESDAY MORNING, FEB. 21

Joint Chairmen, B. F. Tillson and H. F. Lunt

Efficient Ventilation of Metal Mines. By D. Harrington.
Ventilation of Butte Mines of Anaconda Copper Mining Co. By A. S. Richardson.
Coal-mine Ventilation. By J. J. Walsh.

**Safety Session†**

WEDNESDAY AFTERNOON

Joint Chairmen, B. F. Tillson and H. F. Lunt

Bureau of Safety of Anaconda Copper Mining Co. By C. W. Goodale and J. L. Boardman.
Electric Signal Installation in Butte Mines. By C. D. Woodward.
An Inventory of Results of Accident Prevention in Utah. By C. A. Allen.

**Industrial Relations Session**

TUESDAY AFTERNOON, FEB. 21

Chairman, Robert Linton

Reports of Sub-Committees on:

| | |
|---|---|
| Americanization. | Housing and Recreation. |
| Cripples in Industry. | Mental Factors in Industry. |
| Education. | Prevention of Illness. |
| Employment. | Safety. |

Preservation of Natural Scenery and Attractiveness of Mining Camps. By George F. Kunz.

**Non-metallic Session**

WEDNESDAY MORNING, FEB. 22

Chairman, H. Ries

Non-metallic Mineral Filler Industry. By W. M. Weigel.
Undesirable Diversity in Non-metallic Mineral Products. By Oliver Bowles.
Potash Reserves in West Texas. By David White.

**Institute of Metals Division**

MONDAY AFTERNOON, FEB. 20

Chairman, W. H. Bassett

‡Results Achieved by Corrosion Committee of British Institute of Metals. By E. E. Thum.
Experiments with Sherardizing. By Leon McCulloch.
Spectrum Analysis in an Industrial Laboratory. By Wm. H. Bassett and C. H. Davis.
Arsenical Bearing Metals. By Harold J. Roast and C. F. Pascoe.

TUESDAY AFTERNOON, FEB. 21

Chairman, W. H. Bassett

Business Session of the Division.
‡Slip Interference Theory of Hardening of Metals. By Zay Jeffries and R. S. Archer.
Crystal Structure of Solid Solution. By Edgar C. Bain.
‡Thermal Expansion of Copper and Some of its Important Alloys (Bureau of Standards). By P. Hidnert.
‡Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel and Aluminum (Bureau of Standards). By P. Hidnert and W. Souder.
Studies on the Constitution of Binary Zinc-base Alloys. By Willis McG. Peirce.

**Iron and Steel Sessions**

WEDNESDAY MORNING, FEB. 22

Chairman, Bradley Stoughton

This session was in memory of Prof. J. W. Richards.

Application in Rolling of Effects of Carbon, Phosphorus and Manganese on Mechanical Properties of Steel. By W. R. Webster.
Acid Open-hearth Process for Manufacture of Gun Steels and Fine Steels. By W. P. Barba and Henry M. Howe.
Effect of Sulfur and Oxides in Ordnance Steels. By W. J. Priestley.
Electrolytic Deposition of Iron for Building up Worn or Undersized Parts. By D. R. Kellogg.

WEDNESDAY AFTERNOON

Chairman, C. P. Perin

Effect of Time in Reheating Quenched Medium-carbon Steel Below the Critical Range. By C. R. Hayward, D. M. MacNeil, and R. L. Presbrey.
Effect of Quality of Steel on Case-carburizing Results. By H. W. McQuaid and E. W. Ehn.
Malleableizing of White Cast Iron. By Arthur Phillips and E. S. Davenport.

**Joint Meeting with Mining and Metallurgical Society**

WEDNESDAY AFTERNOON, FEB. 22

Chairman, Allen H. Rogers, President, M. & M. S. A.

Waste Involved in Preliminary Investigation of Mineral Deposits. By H. Foster Bain.
Factors in Management of Mining Properties Which Lead to Loss and Waste. By Pope Yeatman.
The Elimination of Waste and the Improvement of Efficiency. What are the Economic Fundamentals? By W. R. Ingalls.
Waste in the Coal-mining Industry. By Edwin Ludlow.
The Engineer's Relation to Elimination of Waste in Mining. By J. Parke Channing.

**Local Section Convention**

WEDNESDAY AFTERNOON, FEB. 22

Chairman, Arthur S. Dwight

Informal Discussion of Matters of Interest to the Sections, and Address by L. W. Wallace on the Federated American Engineering Societies.

## THE SMOKER

The annual smoker was held on the fifth floor, Monday night, and packed its capacity, partly due to the large attendance at the technical meetings and more probably due to the seductive notice of the smoker published by the Entertainment Committee, as follows:

* Will not be published by the Institute. Paper of the U. S. Bureau of Mines.

† Joint Session of Mining Section of National Safety Council and Industrial Relations Committee of the Institute.

‡ Published elsewhere, and therefore will not be published by the Institute.

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**J'AIME**

*will present*

**FOLIES MINIERES**

A Revue with Pangs

Fresh from Roaring Camp Theater, Death Valley
With the original cast, including

**Prince Albert, Ricoro, Fatima and the Camel Family**

A wireless telephone furnished musical numbers from a broad-casting station west of the Hudson River. These numbers were interspersed with fake wireless messages, which were telephoned from an outside room, perpetrating various jokes on Institute members and the more or less hectic happenings of the past year, particularly with reference to publication.

The Entertainment Committee offered a prize for the best limericks, and many of these, which were projected on the screen, elicited much fun and applause. After the last one had been shown, Professor Kemp, with his usual inimitable humor, presented the prize, together with a consolation prize, and in addition, a silver-topped cigar jar to F. F. Sharpless, the Secretary

Lawrence Addicks started the limerick idea and then started for Europe.—Safety First? A few of the many clever rhymes submitted are printed below:

Now, who is this Arthur S. Dwight,
Our president after tonight?
He can sinter fine ore,
Win honors in war
And Institute Members delight.

A man who's sincere as polite
Whose doings all square with what's right
A man of broad vision,
Of mental precision—
Who is it? Of course Arthur Dwight.

The Engineers working for Dwight
Were technically put into flight
But they broke all the rules
For they picked up their tools
And put up a helluva fight.

A mucker whose surname was Hall
Fell into the sump, boots and all
'Twould have been a sad thing
If he'd died in the spring
But he didn't; he died in the fall!

We're asked for suggestions on Copper
Here's one that's both fitting and proper
"Just get the right dope
Add a measure of hope
And apply with a medicine-dropper."

There was an old buck from the west,
Who said, as he pulled on his vest,
My clothes are spun copper
Which style is most proper
To strengthen a metal depressed.

There once was a young Russian Colonel,
Who invented a banner infolonel;
It waved with a roar
And was Red (what was more—)
Sheet Copper, the metal Etolonel.

BUFFET LUNCHEON ON THE FIFTH FLOOR OF INSTITUTE HEADQUARTERS.

The Institute's Lieut. Col.
Is running a new mining jol.
But Rickard and Spurr
Have kicked up a stir
As if the whole thing were infol.

There was a Director, named Rand,
All gentleness mingled with sand.
He tamed the wild Civils,
Who'd acted like divils,
And now they eat out of his hand.

Charlie Goodale is with us from Butte,
On his annual mid-winter toot,
You may Charlie behold
With a medal of gold
Which just seems its owner to suit.

During the first half of the entertainment, one end of the room was concealed by a curtain; when this was drawn, it revealed a regular, honest-to-goodness, old-fashioned, mining-camp bar-room scene, with a 24-ft. bar, all of the plate-glass mirrors, bronze ladies holding colored electric lights, the usual bottles and signs and

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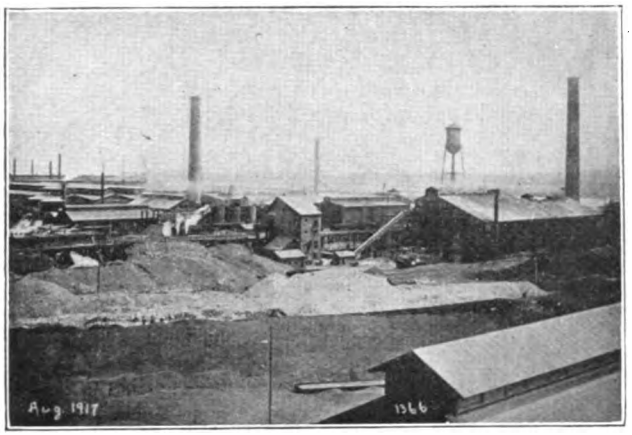
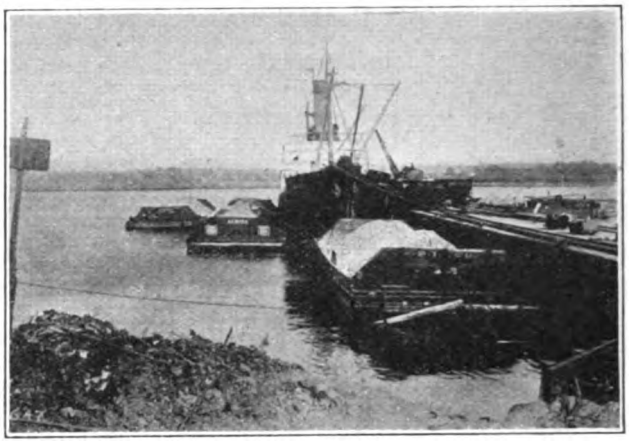
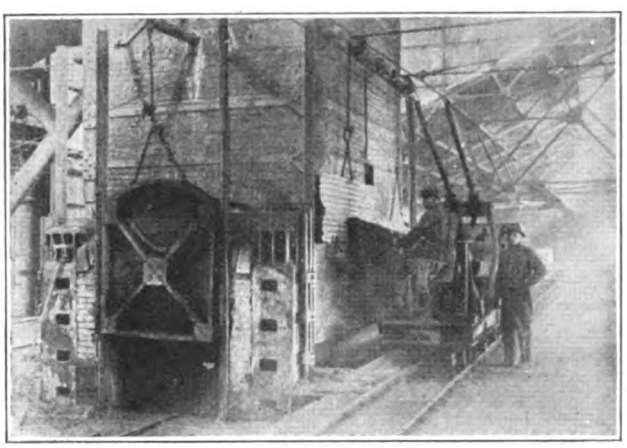


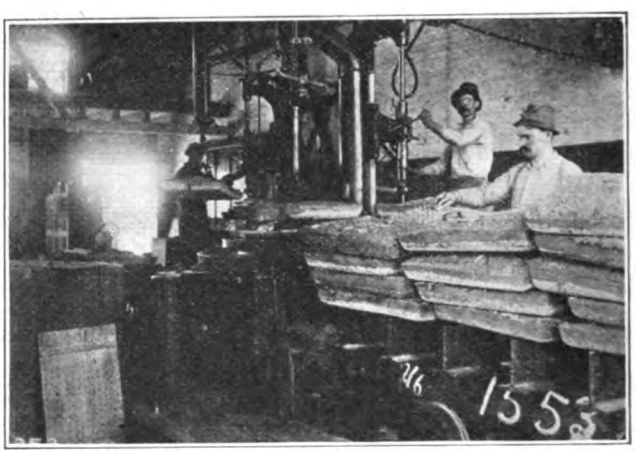

GENERAL VIEW OF PLANT.



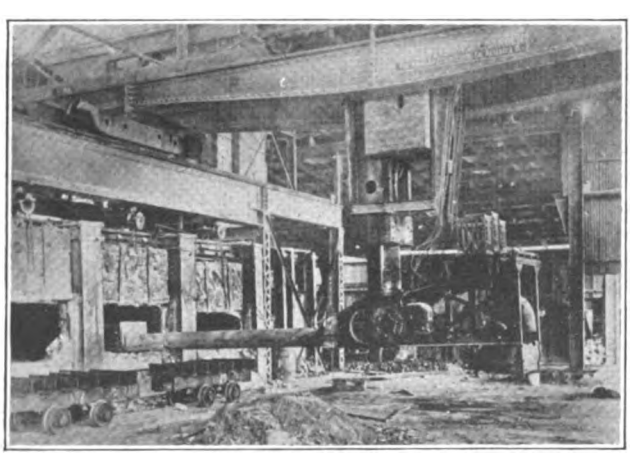
ORE DOCK.



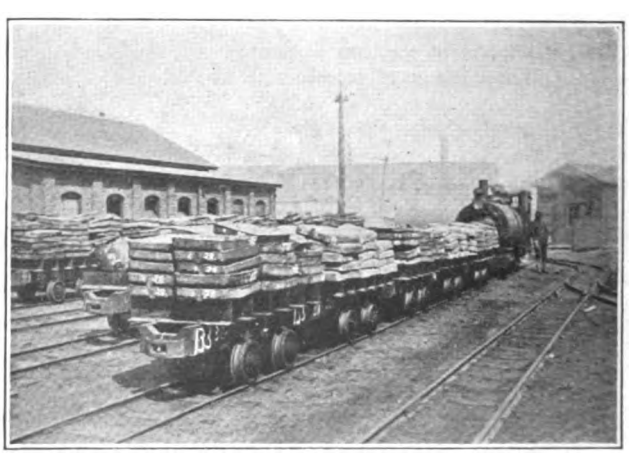
BLAST-FURNACE CHARGING FLOOR.




BLISTER COPPER SAMPLING.



CHARGING BLISTER COPPER INTO ANODE FURNACES.



NARROW-GAGE TRANSPORTATION.

UNITED STATES METALS REFINING CO., CHROME, N. J.

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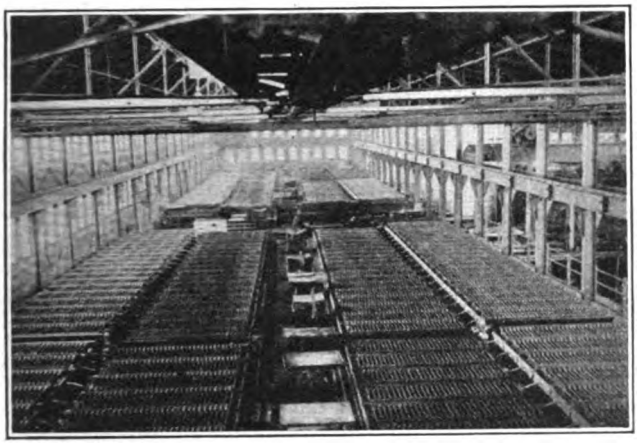
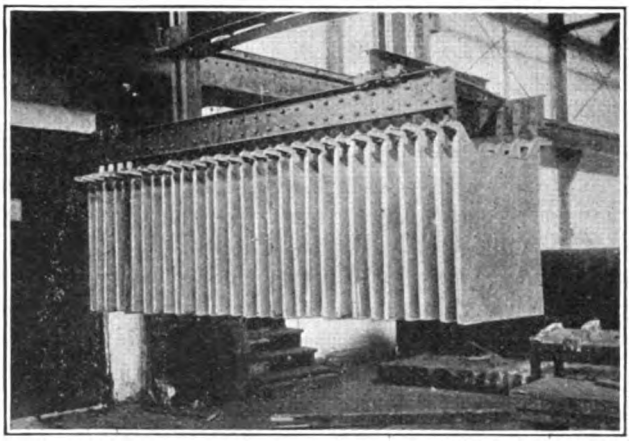
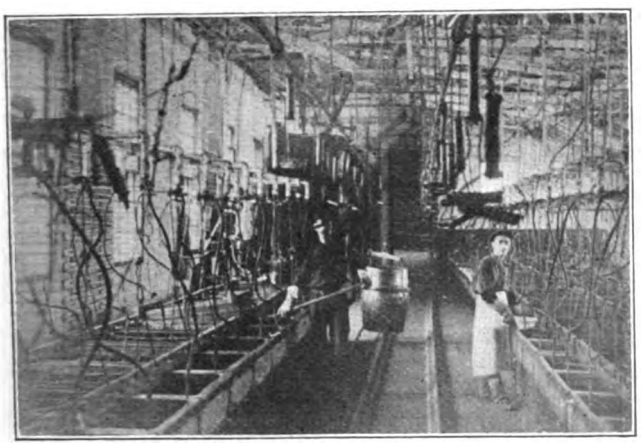


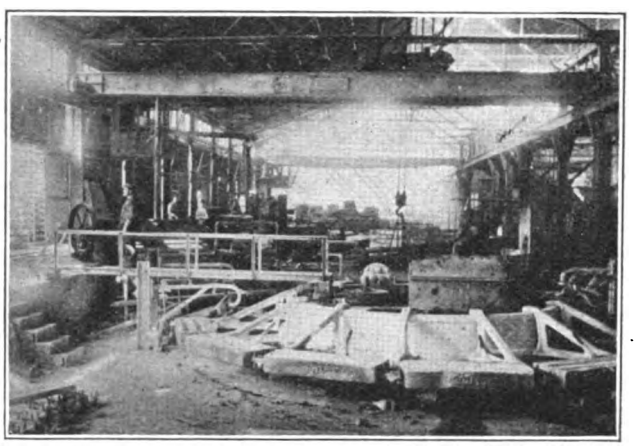
GENERAL VIEW OF ELECTROLYTIC TANK HOUSE.



ANODES READY FOR PLACING IN TANKS.

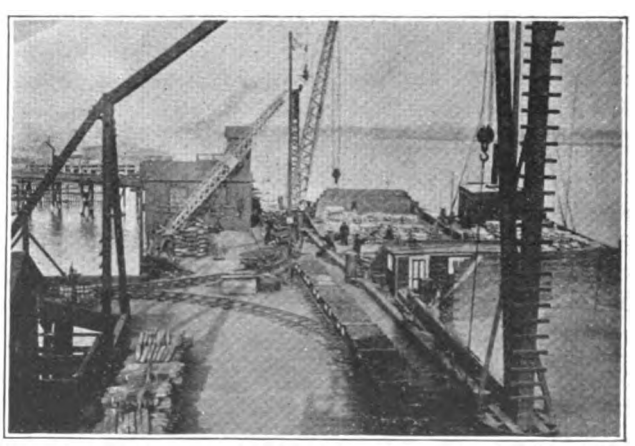


GENERAL VIEW OF ELECTROLYTIC PARTING PLANT.



WIREBAR CASTING WHEEL.

REFINED COPPER IN STORAGE.



LOADING REFINED COPPER FOR EXPORT SHIPMENT.

UNITED STATES METALS REFINING CO., CHROME, N. J.

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two beer kegs, one on each end of the bar. Lined up in front of the bar were half a dozen miners and cowboys in slouch hats, red shirts, chaparejos, six-shooters and all of the fixings to make the picture realistic. This group was composed partly of professional entertainers and partly of Institute members. There was a piano at the end of the bar and the professional entertainers using this had a typical western mining-camp entertainment especially prepared for the occasion, which vividly brought back the by-gone days and aroused much enthusiasm and applause from the audience. In the midst of the hilarity, a desperado with his face veiled by a black and white checkered handkerchief rushed in and held up the entertainers in what used to be true Wild Western style but should now be called true New York style.

The bar and the surrounding walls were covered with most interesting and realistic signs. For example, on one end a sign announced "First Chance, Wash the Dust Out of your Mouth," "Last Chance, 25 Miles to Tonopah." At the other end, "The Stage Stops for Five Drinks." A most appropriate sign was one occupying the place of honor on top of a long necker in the middle of the bar (which probably came from the National Safety Council), which read

DANGER

KEEP OFF THIS TIPPLE

SAFETY FIRST

After the fixed entertainment, the invitation came over the wireless telephone to liquor up and from then on to the end of the evening the bar was a busy place. For those who did not like near-beer (nor the contents of the kegs) there was cider and coffee for some, and free lunch for all. It was the Institute's most pretentious and best attended smoker and many congratulations were offered to A. C. Ludlum and his committee.

### The Banquet and Other Social Events

On Tuesday evening, the large room on the fifth floor was filled with members and guests to see two moving pictures, entitled "Mexico and Its Oil" and "Through India with the Duke of Connaught, including a visit to the Tata Iron and Steel Works," fine and interesting films. Following these the room was cleared of seats and an informal dance was held.

On Wednesday evening the Institute's annual banquet and ball were held in the grand ballroom of the Pennsylvania Hotel; 645 covers were laid, making it within seven of the largest banquet the Institute has ever held at its annual meeting. George Otis Smith, of the U. S. Geological Survey, was toastmaster and the only two speakers were our retiring and newly elected presidents, Edwin Ludlow and Col. Arthur S. Dwight.

Past President Edwin Ludlow, in his speech, took up in considerable detail the work of the Institute during the year of his administration, giving figures of the financial condition, the increase in membership, and the improved condition of the magazine Mining and Metallurgy. He spoke at length on the local sections, their increasing number and their growing usefulness to the parent body. The year of his administration was a memorable one, being the 50th anniversary of the Institute, which was celebrated by a notable meeting at Wilkes-Barre in September, 1921. He reviewed the amenities between the English and French societies and the national engineering societies of this country resulting from the visit of the John Fritz Medal Delegation to confer medals on Sir Robert Hadfield and Eugène Schneider, and also reviewed the work of the Federated American Engineering Societies, with which he is connected as a member of American Engineering Council.

Colonel Dwight said: "It has become the time-honored custom at these annual dinners of ours to put upon the outgoing president the duty of talking about Institute affairs, and to leave the incoming one considerable freedom in choosing his own subject and perhaps to inflict upon his friends some ideas that he might not be allowed to perpetrate at any other time." His address* was entitled "Prospecting and Research," and was a tribute to the old prospector who has now "disappeared into the limbo of the past, with the red man and the buffalo; vanished before the very tide of civilization and progress of which he was the forerunner, and which, indeed, he himself evoked."

Colonel Dwight sees scientific research considered in its broadest sense as the natural successor of the prospector, who, though quite necessary in the beginning of the discoveries of our mineral deposits, has been eliminated by the very conditions that made for perfection in the industry. He believes that "It is not only along mechanical lines that we need stimulation. We must look to the geologist to shape his studies more and more toward the practical requirements of the miner, and to change his role from that of historian after the fact to that of prophet and leader. He must find a way to tell us the nature of the hidden orebody and its relative richness by reading the handwriting of Mother Nature that he finds in the weathered rocks of the outcrop, or the neighboring rocks of the deeper workings, so that the miner may confidently follow his indications. He must discover the Rosetti Stone that will furnish the key to interpret these hieroglyphics of the Earth Gods."

"In the field of metallurgy the possibilities are still more evident. The research work that is being done is concerning itself principally with the products rather than with what may be called the grand problems of metallurgy, for there is a crying demand from the trade for improving the quality of the metallic prod-

* Will appear in full in the April Mining and Metallurgy.

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ucts, eliminating impurities, forming new alloys with special properties; but established industry is instinctively conservative when it comes to anything that might threaten the value of existing plant investment. The inclination is to let well enough alone, and let the other fellow do the experimenting if he wants to. Therefore, the thought of fundamental changes in process or apparatus is not always a welcome one, and comparatively little encouragement is offered for this kind of research on the larger working scale necessary for the convincing demonstration of any new process. This is natural enough, but does not make for progress." "All these questions depend, in the last analysis, on the human factor, for a skillful metallurgist will produce better results with a tumble-down, out-of-date plant, than his less resourceful neighbor may with all the modern improvements."

These annual banquets go off so smoothly under the skillful hand of Captain D. M. Liddell, chairman of the committee, that few people realize the tremendous amount of work involved, necessitating almost invariably one sleepless night before the event. The mathematical seating arrangements for "first come, first served" works out very well, but entire tables are often purchased by members arranging their own guests. One table seating list of this kind was changed five times. Some diners thoughtlessly took seats near friends whom they had not seen for a long time, regardless of the fact that these seats had been assigned to others. The work of this committee is increased by the fact that the individual wishes and prejudices of all the members are catered to so far as is possible. Captain Liddell suggests that it would be a grand experience to make out the seating arrangement according to his own desires, get it into print just before the dinner and leave immediately for parts unknown.

Lunches were served every noon on the fifth floor, as in years past, but the law of averages failed to work in 1922. The first day lunches were provided for the largest number that had ever attended such functions, plus a factor of safety, yet the caterer was eaten out of house and home before everyone was supplied. Arrangements were made to supply the correspondingly large number on Tuesday, but there again the attendance at the meetings exceeded expectation. The hungry members were lunched at the club. A third effort was made on Wednesday and not only was every one supplied but a most delightful lunch was provided. The ladies attended these lunches, excepting on Tuesday. This is a feature that is not a part of the conventions of the other national engineering societies.

Senator William A. Clark generously opened his art galleries to the members and guests of the Institute. More than 500 tickets were issued at the Registration Desk to those who desired to enjoy this rare treat, for which we have been indebted to Senator Clark so many times. As usual, a delightful tea at Senator Clark's home followed the inspection of his art collection.

"I'M OUT OF IT ANYWAY"
"IF THEY ARE GOING TO ROAST ME, I HOPE THEY WILL AT LEAST USE A GOOD MACHINE FOR IT."
DWIGHT
LUDLOW
ANYWAY THERE MIGHT HAVE BEEN MORE SPEAKERS
IT HAS BEEN A HARD YEAR FOR ENGINEERS"

CARTOON ON COVER OF MENU AT ANNUAL BANQUET.

## ENTERTAINMENT OF LADIES

The Womans' Auxiliary had a longer and more attractive, and probably more strenuous, program than usual. A full report of the events will appear in the April MINING AND METALLURGY. As outlined on the program, they included a reception by Mr. and Mrs. Edwin Ludlow at the Hotel Ambassador, a luncheon and card party given by Mrs. George D. Barron at her home in Rye, visits to the Roosevelt Memorial and other places of interest, and a theater party.

## EXCURSIONS ON THURSDAY

The fourth day of the convention was devoted to excursions, which this year were made to various industrial plants in New Jersey. The excursionists assembled at the Ferry House of the Central Railroad of New Jersey at the foot of West 23rd St. at 8.55 a.m. This place of meeting was chosen both for convenience

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and to give the out-of-town visitors who arrived by tunnel the opportunity of seeing the New York waterfront on the trip down the river to the Central Railroad Terminal in Jersey City. The ferry boat got lost in the fog, and not only was the New York skyline not visible, but the party was an hour late in reaching its destination. However, the weather changed and on the return trip in the evening the tall buildings with their myriad lighted windows presented a beautiful picture.

The special train from Jersey City took the oil group to the Bayway plant of the Standard Oil Co. (N. J.); the steel group to the plant of the Crucible Steel Co. of America, Harrison, N. J., and the copper group to the Chrome plant of the U. S. Metals Refining Co. About two hours was allowed for seeing these plants. The special train collected the different groups and took them to Perth Amboy, N. J., where they were entertained at luncheon by the Industrial Association of that city.

The gymnasium at the Y. M. C. A. had been converted into a large dining room, seating 400 people, and a delicious luncheon was served by ladies of Perth Amboy. The committee representing the Industrial Association included A. Clayton Clark, C. C. Baldwin, Nathaniel Pierce, G. H. Hawley, J. N. Pyster, Joseph Slutzker, C. W. Hill, John Pfeiffer, R. W. Atkinson, H. W. Fisher and Albert Waters.

The ladies entertainment committee consisted of Mrs. C. C. Baldwin, Mrs. Ferdinand Andrews, Mrs. Kenneth McComas, Mrs. J. V. Shull, Mrs. William DeHaven, Mrs. A. Clayton Clark, Mrs. Peter C. Olsen and Mrs. Nathaniel W. Pierce.

In the afternoon, many of the ladies were entertained at the Raritan Yacht Club, and a few accompanied the members and men guests on visits to the copper-fabricating plant of the Standard Underground Cable Co.; the copper-refining plant of the Raritan Copper Works, where oil is largely used as fuel; the roofing plant of the Barber Asphalt Paving Co. at Maurer, N. J., or the refractory plant of Henry Maurer & Son.

The groups reassembled on the special train, and reached New York at 6 p. m.

It is difficult to adequately describe these trips or to do justice to the courtesy and painstaking care of the plants entertaining the visitors. Each plant had been carefully organized; the party was divided into small groups, each group in care of a guide who conducted his party over a stipulated route and freely answered the questions asked. Souvenir booklets, printed descriptive matter, and souvenirs were distributed. At both of the copper refineries large amounts of gold and silver bullion and other precious metals, as well as samples of copper ore in various stages of preparation, and the refined product, were exhibited. Each visitor to the U. S. Metals Refining Co. at Chrome came away with a beautiful little copper ingot and from the Raritan Refining Works of the Anaconda company with a little copper wire bar.

## Appreciation Recorded

The Board of Directors, at its meeting on Tuesday, passed the following resolution:

**Resolved that the thanks of the Institute and of the Board of Directors be most heartily extended to the Chairman and Members of the Committees who so admirably carried out the program and arrangements of the 125th Meeting of the Institute.**

**Our thanks are also extended to the women who assisted in the entertainment of our guests and to members who so generously contributed their financial support.**

The committees responsible for this successful meeting were:

*General Executive Committee.*—William Young Westervelt, *chairman;* Robert Linton, *vice-chairman;* E. L. Gruver, *secretary;* C. C. Burger, John A. Church, Jr., William C. Coffin, Ralph W. Deacon, E. L. DeGolyer, J. V. N. Dorr, Karl Eilers, Fred Hellmann, Louis D. Huntoon, C. V. Jenkins, Wilber Judson, Donald M. Liddell, Richard L. Lloyd, Albert C. Ludlum, Harris K. Masters, John A. Mathews, A. J. McNab, Carl A. Meissner, P. A. Mosman, Herman A. Prosser, R. M. Raymond, Sidney Rolle, Forest Rutherford, Bradley Stoughton, Arthur L. Walker, Daniel A. Welch, Mrs. Arthur S. Dwight.

The sub-committees were made up as follows:

*Finance Committee.*—Karl Eilers, *chairman;* Walter H. Aldridge; George D. Barron; W. A. Clark; W. E. Corey; Walter Douglas; Arthur S. Dwight; H. W. Hardinge; Albert R. Ledoux; L. D. Ricketts; John D. Ryan; Benjamin B. Thayer.

*Banquet Committee.*—Donald M. Liddell, *chairman;* C. C. Burger, *vice-chairman;* G. P. Bartholomew; Colin Garfield Fink; George F. Kunz; Ralph S. Rainsford; Richard H. Vail; Mrs. Colin G. Fink.

*Entertainment Committee.*—Albert C. Ludlum, *chairman;* Louis D. Huntoon, *vice-chairman;* Lawrence Addicks; C. A. Burdick; Lucius W. Mayer; Theodore Pilger; Frederick Taber Rubidge; Ernest E. Thum.

*Excursion Committee.*—Ralph W. Deacon, *chairman;* Sidney Rolle, *1st vice-chairman;* A. W. Carroll, *2nd vice-chairman;* D. E. A. Charlton; Thomas E. Fisher; Philip W. Henry; Frank H. Ramsey; Stanislaus Showronski; Frederic R. Weekes.

*Hotel Committee.*—Wilber Judson, *chairman;* A. J. McNab, *vice-chairman;* H. N. Spicer; Frederic Richmond Kennedy.

*Luncheon Committee.*—P. A. Mosman, *chairman;* Forest Rutherford, *vice-chairman;* Charles A. Bohn; Guy C. Riddell; Andrew W. Newberry.

*Reception Committee.*—R. M. Raymond, *chairman.*

*Ladies' Committee.*—Mrs. Arthur S. Dwight, *chairman;* Mrs. W. H. Aldridge; Mrs. P. E. Barbour; Mrs. G. D. Barron; Mrs. C. A. Bohn; Mrs. C. C. Burger; Mrs. A. W. Carroll; Mrs. D. E. A. Charlton; Mrs. J. A. Church; Mrs. W. C. Coffin; Mrs. Karl Eilers; Mrs. R. W. Deacon; Mrs. E. L. DeGolyer; Mrs. Walter Douglas; Mrs. C. G. Fink; Mrs. E. L. Gruver; Mrs. H. K. Hardon; Mrs. H. W. Hardinge; Mrs. Fred Hellman; Mrs. Levi Holbrook; Mrs. P. W. Henry; Mrs. L. D. Huntoon; Mrs. S. J. Jennings; Mrs. C. V. Jenkins; Mrs. F. R. Kennedy; Mrs. J. F. Kemp; Mrs. A. R. Ledoux; Mrs. D. M. Liddell; Mrs. Robert Linton; Mrs. R. L. Lloyd; Mrs. Edwin Ludlow; Mrs. A. T. McNab; Mrs. E. P. Mathewson; Mrs. H. A. Prosser; Mrs. R. M. Raymond; Mrs. J. V. W. Reynders; Mrs. G. C. Riddell; Mrs. Sidney Rolle; Mrs. F. T. Rubidge; Mrs. H. W. Spicer; Mrs. Bradley Stoughton; Mrs. F. F. Sharpless; Mrs. F. R. Weekes; Mrs. W. Y. Westervelt. Miss Marguerite Eilers, *junior committee chairman.*

Mimeographed lists of those in attendance may be secured at Institute headquarters.

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# The Presidents of the Four National Engineering Societies

## Arthur Smith Dwight

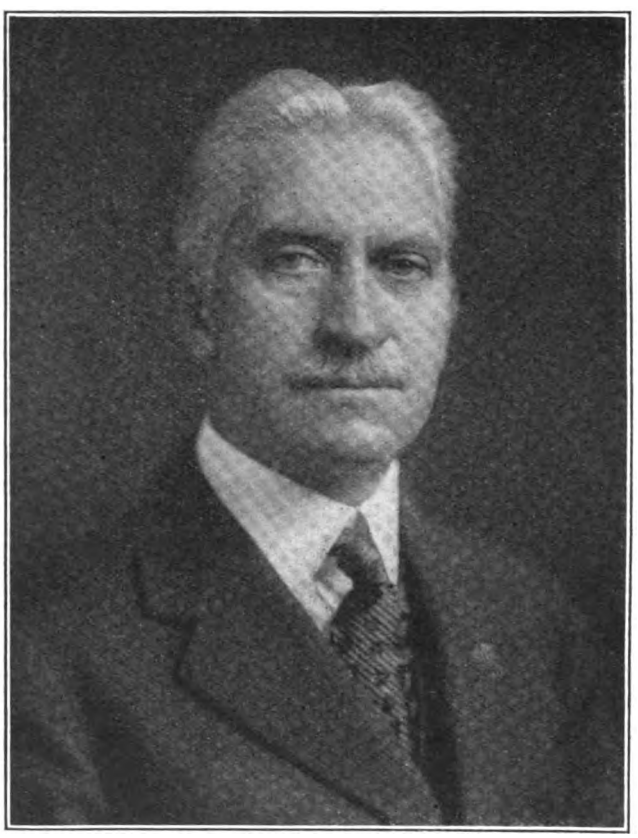
ARTHUR SMITH DWIGHT, president of the American Institute of Mining and Metallurgical Engineers, was born in Taunton, Mass., on March 18, 1864. He is descended on both sides from early settlers, one of whom was Richard Warren, of the "Mayflower." His forebears included Col. Benjamin Church, Timothy Dwight, and the Rev. Jonathan Edwards, third president of Princeton College.

Mr. Dwight was graduated in 1882 from the Polytechnic Institute of Brooklyn, N. Y., and three years later from the Columbia School of Mines, with the degree of Engineer of Mines. In 1914, he received the honorary degree of Master of Science from Columbia.

On leaving Columbia in 1885, he went to Pueblo, Col., and for thirteen years was associated with the Colorado Smelting Co. Beginning as assayer he rose to be general superintendent. When he gave up the latter position he became connected with several large companies in the mining and smelting of lead, copper and the precious metals in the Rocky Mountain region. This work occupied him from 1897 to 1906, and six years of that time were spent in Mexico. He was general manager of the Greene Consolidated Copper Company at Cananea, Mexico, in 1906, when trouble first developed against the régime of Diaz. A general uprising was planned to seize the mines, and with money and supplies so obtained, carry the revolt through the interior. Mr. Dwight turned his industrial organization into a military unit almost over night, stemmed the tide of revolution, and had the situation well in hand before the arrival of troops.

In the fall of 1906 he returned to New York and began practice as a consulting mining and metallurgical engineer. He next developed important metallurgical patents for the roasting and agglomeration of fine ores, known as the Dwight and Lloyd sintering process, now extensively used all over the world.

When the World War began Mr. Dwight became convinced that the United States must eventually enter the fight and he took an active part in preparedness work, particularly in his own profession. He was a member of an engineering committee that coöperated with the War Department in obtaining the creation of the Engineer Officers Reserve Corps, which resulted in a large number of engineers being available when we declared hostilities. Mr. Dwight was one of the first civilians to be commissioned in the Reserve and to enter active service. As Major in the First Reserve Engineer Regiment, he had an important part in recruiting and training that body, which sailed for France on July 14, 1917, as the Eleventh Engineers. This was the first unit of the A. E. F. in action. The behavior of these engineers at Cambrai on Nov. 30, 1917, when they fought the Germans with pick and shovel, thrilled all America.



ARTHUR S. DWIGHT

Major Dwight served in France for more than twenty-two months, nine months of which was spent on the British front. At the request of the French Government he was assigned as special metallurgical advisor to French companies engaged in war work. He was next appointed Engineer Salvage Officer, A. E. F. to organize a reclamation service for the great quantities of war material being wasted on the battlefields. After the armistice he returned home and was discharged in May, 1919. He now bears the rank of Lieutenant-Colonel of Engineers, U. S. Reserve. He received

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the D. S. O. from the British and a citation by General Pershing.

Besides being a life member of the American Institute of Mining and Metallurgical Engineers, he is vice-president of the New York Post, Society of Military Engineers; member of the Executive Board, American Engineering Council; member of the Mining and Metallurgical Society of America; honorary member, Institution of Mining and Metallurgy, London; Military Order of the World War; Engineers, University, and Columbia University Clubs, New York and the Engineers' Country Club.

In 1895, Mr. Dwight was married to Miss Jane Earl Reed, daughter of the late Samuel B. Reed, of Joliet, Ill., who built the Union Pacific Railroad. She accompanied him throughout his pioneering days and after his departure for France succeeded in following, undertaking relief work with the French Red Cross. In January, 1918, she became Regional Directress of the women workers with the Y. M. C. A. at the American front. She was decorated by the French Government with the Croix de Guerre for bravery, and also received other citations.

Mr. Dwight has written extensively on engineering subjects and has been an occasional lecturer at Columbia, of which he is a trustee. He is president of the Dwight & Lloyd Sintering Co. and the Dwight & Lloyd Metallurgical Co.

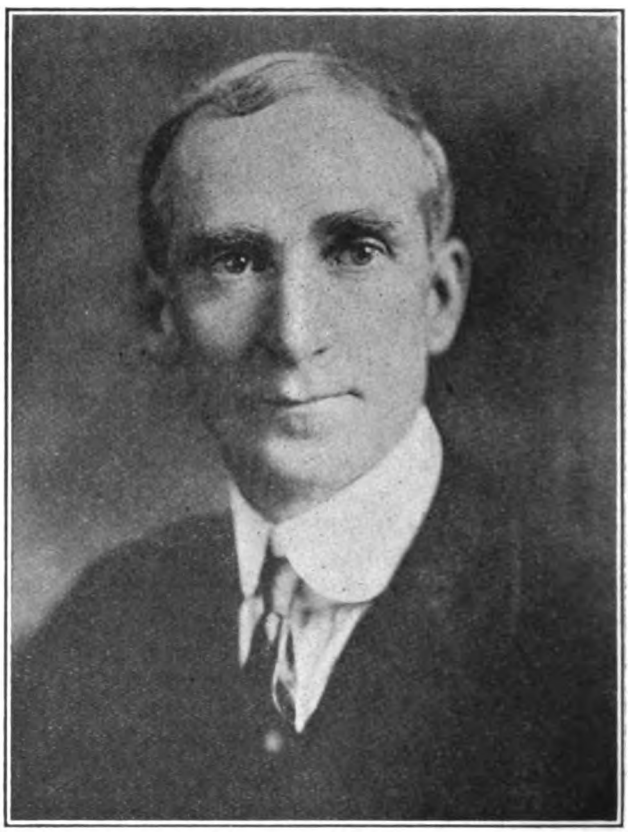
## Dexter S. Kimball

DEXTER S. KIMBALL is the president of the American Society of Mechanical Engineers, elected at the annual meeting in December. Born in New River, New Brunswick, Canada, in 1865, he was educated in California, at Leland Stanford Jr. University. He received the degree of A. B. in 1896, and of M. E. in 1913.

He served his apprenticeship with Pope & Talbot, Port Gamble, Wash., and in the shops and the engineering department of the Union Iron Works, San Francisco. In 1898 he became designing engineer for the Anaconda Mining Co. For three years he served as assistant professor of machine design at Sibley College, Cornell University, then became works manager of the Stanley Electric Manufacturing Co., Pittsfield, Mass. In 1904 he returned to Cornell University as professor of machine design and construction, and since 1915 has occupied the chair of industrial engineering. He became dean of the College of Engineering in 1920.

Dean Kimball is also a member of the Society for the Promotion of Engineering Education, the Society of Industrial Engineers, and of the honorary societies Sigma Xi and Tau Beta Pi, and since 1911, has been a member of the Council on Industrial Engineering of the New York State Department of Education. He is vice-president of The Federated American Engineering Societies.

He is co-author with John H. Barr of "Elements of Machine Design" and is author of "Industrial Education," "Principles of Industrial Organization," "Elements of Cost Finding," and "Plant Management," as well as of many contributions to the technical press.



DEXTER S. KIMBALL

## John Ripley Freeman

JOHN RIPLEY FREEMAN, of Providence, R. I., was elected president of the American Society of Civil Engineers on Jan. 18, 1922. Mr. Freeman received the B. S. degree from Massachusetts Institute of Technology in 1876; an honorary Sc. D. from Brown University in 1904, and from Tufts College in 1905.

For 10 years, 1876-86, Mr. Freeman was principal assistant engineer for the Water Power Co. at Lawrence, Mass., and for eight of those years was also assistant to Hiram F. Mills, consulting engineer. He was Water Commissioner in Winchester, Mass., for four years; chief engineer of the investigations for the Charles River Dam, in 1903; he planned the water-power developments on Feather River, Cal., at Long Sault on the St. Lawrence in 1904 and at the Lachine Rapids in 1914.

He has been consulting engineer on many large water-supply and water-development projects, and has made extensive studies on safeguarding life in theaters, and on sanitary and drainage problems. He was consulting engineer on the Isthmian Canal locks and

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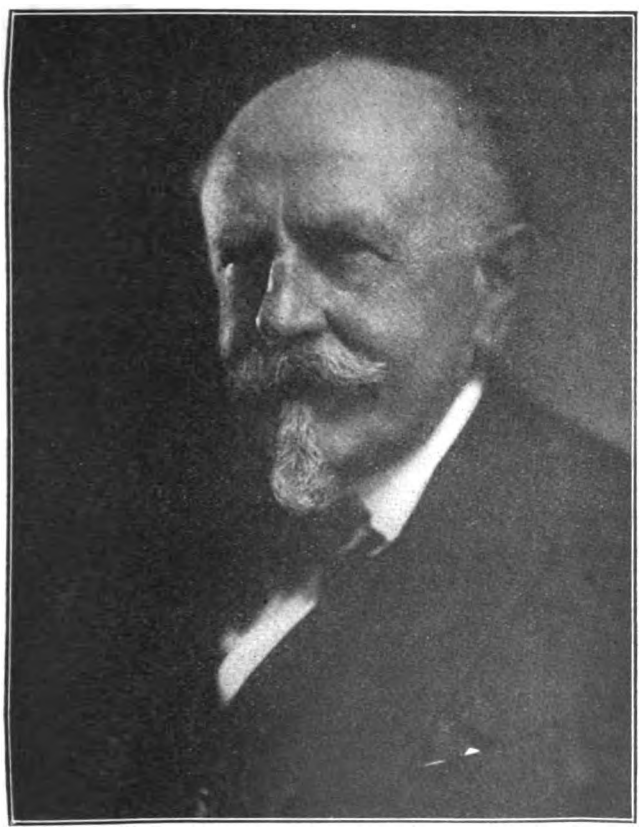
dams, in 1907 and 1909; since 1910, he has been consulting engineer for the San Francisco water supply, and he planned the Hetch Hetchy supply now being built.

At the present time, he is also consulting engineer to the New York Board of Water Supply and to the Grand Canal Improvement Board of the Chinese Government, as well as to various large manufacturing corporations for their water and mill construction.

Mr. Freeman has twice received the Normal medal from the A. S. C. E. for the best engineering paper contributed to its Transactions during the year. He was president of the Boston Society of Civil Engineers in 1893; vice-president of the American Society of Civil Engineers in 1902–03, and president of the American Society of Mechanical Engineers in 1904.

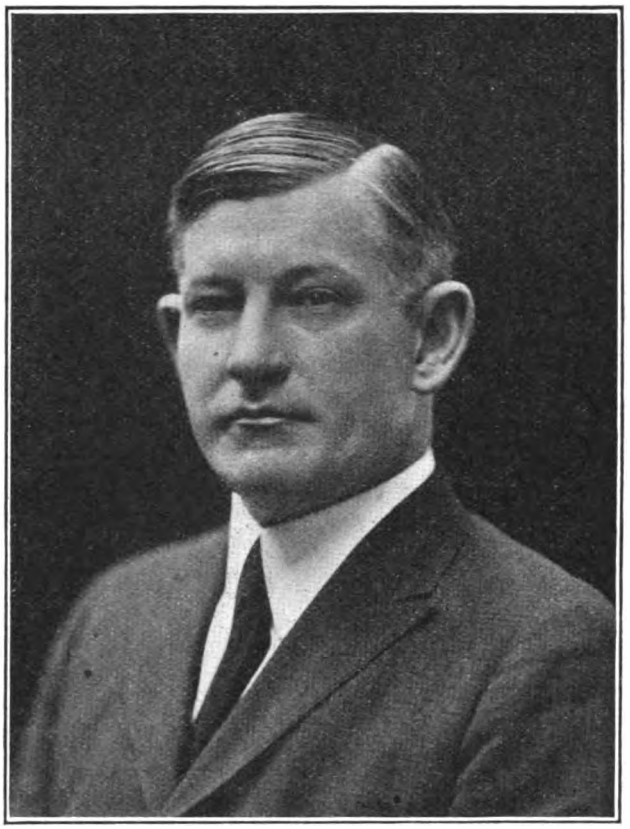


JOHN R. FREEMAN

## William McClellan

WILLIAM McCLELLAN was elected president of the American Institute of Electrical Engineers for the year beginning Aug. 1, 1921. He is a Philadelphian, by birth and education. He was graduated from the University of Pennsylvania in 1900 with the degree of B. S., later took the Ph. D. degree, and in 1913 received the degree of E. E.

Mr. McClellan's early experience was as engineer in charge of construction with the Philadelphia Rapid Transit Co. For several years he was managing engineer with Westinghouse, Church, Kerr & Co., participating in the Pennsylvania Terminal engineering and construction and electrifying the Rochester Division



WILLIAM McCLELLAN

of the Erie Railroad; for several years he was electrical engineer and chief of Division of Light, Heat and Power of the Second District Public Service Commission of New York. He has been associated with the Cleveland Electric Illuminating Co. for about eight years and was for two years one of its vice-presidents. He is a member of the firm of McClellan & Junkersfeld, recently incorporated.

During the war he was director of the Intercollegiate Intelligence Bureau, an organization of more than two hundred of the principal colleges of the United States. For a time he was dean of Wharton School of Finance and Commerce of the University of Pennsylvania.

**The First-aid Training** of the Bureau of Mines is being given extensively in the southern California oil-producing districts. At El Segundo, Calif., 70 employees of an oil-refining company recently completed the course. At Platteville, Wis., first-aid and mine-rescue instruction has been given to the students of the Wisconsin State Mining School. At the request of the Los Angeles Fire Department, the city firemen of that municipality have been given the instruction. The senior and junior students of the Mining College of the University of Wisconsin at Madison, Wis., have also recently taken the course.

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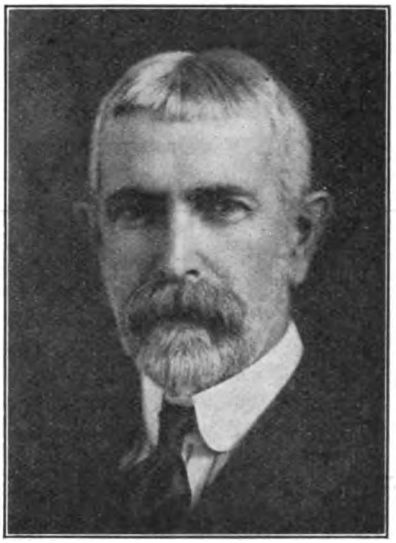
HERBERT HOOVER
PAST PRESIDENT



EDWIN LUDLOW
PAST PRESIDENT

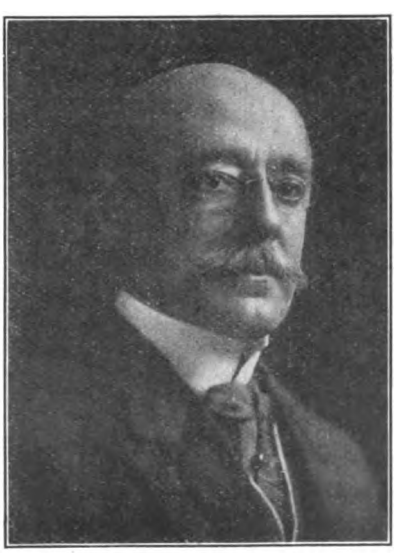
J. V. W. REYNDERS
FIRST VICE-PRESIDENT

FREDERICK LAIST
VICE-PRESIDENT

OFFICERS
AND
DIRECTORS
FOR
YEAR BEGINNING
FEBRUARY
1922

SEELEY W. MUDD
VICE-PRESIDENT

E. L. DE GOLYER
VICE-PRESIDENT



A. R. LEDOUX
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ALBERT BURCH
VICE-PRESIDENT

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W. M. CORSE
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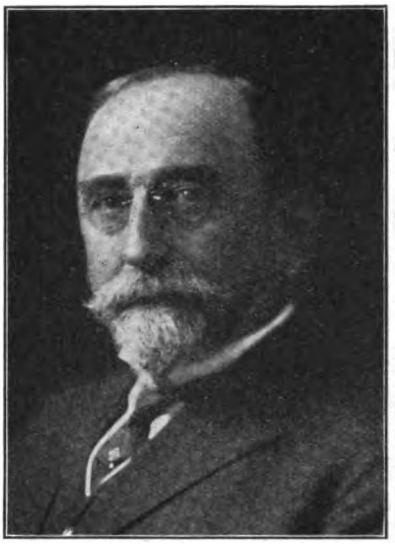
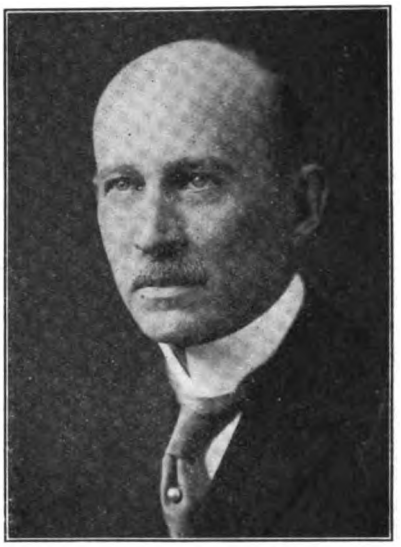


R. M. CATLIN
DIRECTOR

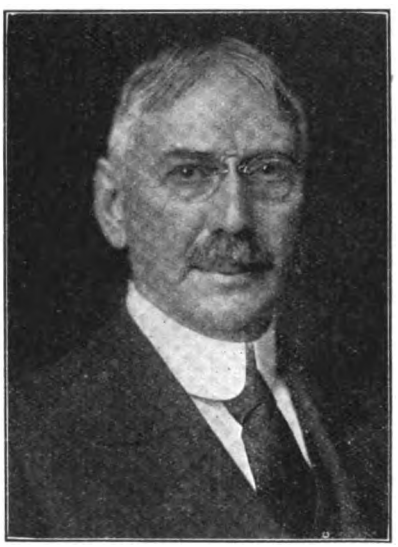


W. H. ALDRIDGE
DIRECTOR

OFFICERS

AND

DIRECTORS



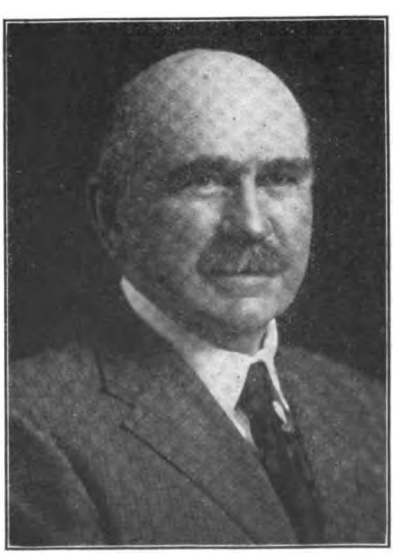
CHARLES F. RAND
TREASURER

YEAR

BEGINNING

FEBRUARY, 1922

G. H. CLEVENGER
DIRECTOR



E. P. MATHEWSON
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R. V. NORRIS
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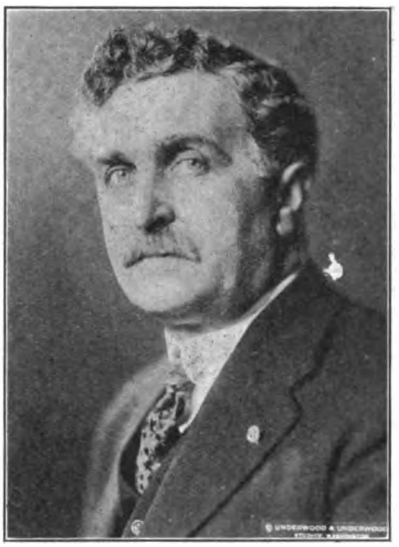
W. G. MATHER
DIRECTOR



GEORGE OTIS SMITH
DIRECTOR

W. E. WRATHER
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J. C. GREENWAY
DIRECTOR

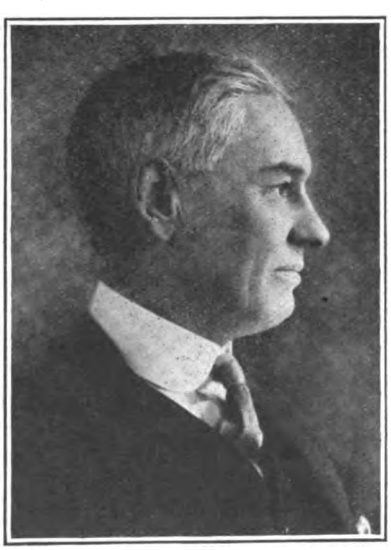
DIRECTORS

FOR YEAR

BEGINNING

FEBRUARY, 1922.

GEORGE. D. BARRON
DIRECTOR



THOMAS B. STEARNS
DIRECTOR

WILLIAM KELLY
DIRECTOR

W. H. BASSETT
DIRECTOR

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# Waste Involved in Preliminary Investigation of Mineral Deposits*

By H. FOSTER BAIN

Director of the Bureau of Mines, Washington, D. C.

THIS subject is one that has attracted my attention for a good many years. All of us have had occasion to think of the waste that comes from the poor organization of our methods of finding mines and of looking after prospects. Probably all of us, in examination work, have made a long and difficult journey to see some prospect, in a far country, or often in the mountains, have found the prospect one that never could be developed, and have learned for the first time that it had been previously examined by from two to six of our professional associates, who, each in turn, condemned the property as worthless.

I know properties, as all of you do, that have been repeatedly examined by first-class engineers. Perhaps it would not be safe or wise to have an invariable rule that each prospect should be entitled to only one examination by one engineer; and yet, it seems to me that somewhere there is a middle ground to take; it is hardly necessary that each little prospect should be examined so many times that the walls get greasy from the climbing of mining engineers, or the stopes get filled up with cigarette stumps. This mining engineering profession ought to have brains enough to find some way of making this unnecessary, and of making the benefit of an examination, in some cases at least, and in a much larger number of cases than at present, available to the industry as a whole.

If we would save the amount of money that is spent unnecessarily on reëxamination of properties, and let that money flow into the actual development of properties, I believe that, in the long run, we would be better off. Just how to do that is another problem.

In 1916, while in London, Edgar Rickard and I attempted to do something of that kind. We started to organize a plan whereby mining engineers might, with the consent of their class, turn over to a central organization their reports on properties they had examined, whereby men who had occasion to look up these same properties might, on payment of a fee (which should go back to the original client, if you desire, or might be devoted to some other purpose for the benefit of the industry), have access to these earlier reports. We found, in the short time we considered this matter, that a good many British engineers, and a good many of the companies, were willing to consider this. In other words, they were willing to pool their information, as a matter of practical experience. We all know the enormous value of pooling information. I think it is a problem that may well be considered from the point of view of the industry as a whole, which the Society might attempt to work out on a businesslike basis.

Assuming, however, that it is possible to work out a plan whereby we get the minimum number of examinations that are necessary and we make some saving in money, we reach another stage—the problem of the examination itself.

## Some Examinations Too Narrow

In that work, as we all realize, there has been, in the past, a great deal of money wasted from making too narrow an examination. A specialist in a particular direction looks for that particular thing and in a good many cases properties have been turned down and sometimes development has been poorly started because, for example, the specialist did not have adequate knowledge of the geology of the district. To illustrate, an examination of placer ground with a view to dredging should take into account some knowledge of the physiographic history of that region, because that is a very important factor in the possibilities of the accumulation of gold for placer, and also in certain of the copper properties.

We have not always, as engineers, taken advantage of the information that is available along that line. We are not as familiar as we might be with the results that our associates, working a strictly scientific field of work with the geological surveys, state and national, have obtained, which bear upon that problem. If we could think from a little broader point of view, I believe it would often be helpful and would perhaps help to bring in new properties.

There is one other phase of waste in connection with this matter of development of properties that is very much to the fore now. The development of properties upon the public lands of the West has been in the past

* Address at Joint meeting of the Mining and Metallurgical Society of America and American Institute of Mining and Metallurgical Engineers, Feb. 22, 1922.

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through the process of location and doing or not doing assessment work up to the point of patenting or selling the claim to some one who will take it up on behalf of the company. All who are familiar with the West know that, in a large way, that assessment work has been a farce. Very often it has been done in places where it has simply meant an expenditure of money and has brought no practical results; and yet there is a widespread feeling throughout the West, and a feeling that I find some of the engineers who act as scouts can sympathize with, to the effect that it is only by miscellaneous digging around over the country that mines have been found in the past and that through that same process we may expect to find them in the future.

### Best Practice Needed Everywhere

My own feeling is that the time has come when we should take serious thought of this, and determine whether that system of prospecting is going to be as valuable in the future as it has been in the past; and whether we have not got to develop some different methods so that, for example, the man who is a claim owner may, if he wishes, instead of doing prospect work, put money into it and find whether it can be used in some other form, for the benefit of the district. This is one of the proposals in the bill for the revision of the mining law which is now before Congress; and I may say, incidentally, it is one of the proposals that provoked the most outcry in the West. The individual prospector has got it into his head that it is going to interfere tremendously with his prosperity and happiness, and I believe it is a thing of sufficient importance to warrant the attention and some of the energy and thought of the engineers of the profession.

There is still another stage in which waste enters into this field. The Bureau of Mines was established with the idea of increasing safety and decreasing waste in the mines, and when the first appropriation was made, for studies in miscellaneous resources, Doctor Holmes employed Professor Parsons to make a general summary or review of the waste in the mining industry. I have not those figures at hand but they showed an enormous amount of waste in the little industries of the country—the non-metallic industries which are largely in the hands of people of small capital, of small experience, who are not capable, perhaps, of organization into such big units as copper mining, for example. There is a tremendous waste in all of that field and a good deal can be done. If we could get everywhere in the mineral industry the best practice that is now in the mineral industry, we could make an enormous saving both of material and effort and energy.

There is a tremendous amount of good that can come, too, from spreading out into one branch of the mineral industry the knowledge that exists in the other branches. We had an example of that this year in some work done by the Bureau in coöperation with four of the big brick manufacturers' associations. Brick is one of the materials of which the price has not come down and an effort was made to find out, if possible, some way of reducing the cost to the manufacturer without throwing the reduction altogether upon labor.

The two big elements entering into the cost of brick are labor and fuel, so that the natural point of attack was fuel. With this general problem before us, we put into the study of the brick industry some of the men from the Fuel Division who had done such long and successful work in the study of combustion problems in steam-boiler practice; and as a result of the first investigation, which was made at a brickyard, it was found that it would be possible to decrease the amount of fuel used in that particular yard by 140 tons per month. In a general way, in the three big yards that have been tested, it has been shown that it will be possible to cut the fuel consumption about one-third, the time of burning substantially the same amount and, in two out of three cases, to improve the quality of the product.

That was merely a matter of bringing into one branch of the industry the knowledge already available in another branch of the industry; so that we come back to the thing that as engineers we so often have to think of, and that is, the biggest waste of all is the waste of technical knowledge. Every time we bring technical knowledge out of its hiding places and make it available to the whole industry, we have done something of benefit to the industry.

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## A. S. and R. Wage Analysis

A WAGE analysis of the American Smelting and Refining Co. (U. S. plants) for the year 1921 shows that readjustments produced further slight decreases in the December, 1921, rates of pay compared to November rates, but the wages paid were, in December, still 65 to 66 per cent. above pre-war rates.

Indicating how labor costs were factors in increasing the cost of production, the analysis shows that, in 1914, repair, supply and construction labor was paid an average of $2.42 for an 8-hr. day, while in November, 1920, the rate was $5.39, an increase of 123 per cent. The rate for direct operating labor in 1914 was $2.02 per 8-hr. day, but in October, 1920, it had risen to $4.55, an increase of 125 per cent.

In December, 1921, through various readjustments, the rates for repair, supply and construction labor had been reduced to $4 for an 8-hr. day. This was a decrease of ½ per cent. compared to November rates, but 25.9 per cent. below the highest rate, $5.39, paid in November, 1920.

Similarly, the rate of $3.37 in December, 1921, for direct operating labor was 1.1 per cent. below the November rate, and 25.9 per cent. less than the record rate of $4.55 for this class of labor in October, 1920.

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# Factors in Mine Management That Lead to Loss and Waste*

By POPE YEATMAN
Consulting Engineer, New York City

THE Committee on the Elimination of Waste in Industry, of the Federated American Engineering Societies, in its report says that "Waste in industry is attributable to four causes:

1. Low production, caused by faulty management, of materials, plant, equipment, and men;
2. Interrupted production caused by idle materials, idle plants, and idle equipment;
3. Restricted production intentionally caused by owners, managers, or labor;
4. Lost production caused by ill-health, physical defects and industrial accidents.

The committee sent out elaborate questionnaires, and in them divided the responsibility into Management, Labor, and Outside Contracts. These questionnaires showed that in the different industries examined the responsibility of Management was from 50 to 80 per cent. and of Labor from 9 to 28 per cent. The percentage of responsibility that Management was held accountable for was much larger than any of us supposed. However, when this question is studied, we realize how necessary it is to select, in the first instance, suitable personnel, in the form of directors, managers, heads of departments, experts, etc.

We would like to believe that the percentage of responsibility of Management for waste in the mining business was less than that quoted above, but there are so many mining properties started up and operated by men of no experience in such lines, and there have been so many improvements in late years in mining and metallurgical methods not taken advantage of, that we can not believe that the percentage will vary much from that already quoted.

Quoting from a report approved by the Committee on Management of the American Society of Mechanical Engineers:

Management is the art and science of preparing, organizing, and directing human effort applied to control the forces and utilize the materials of nature for the benefit of man.

When we speak of management, we have in our minds one person or one directing authority. In reality, however, except in the case of a small property owned and worked by one individual, the management consists of a number of individuals, and the conduct of operations is not alone in the hands of the manager, but is carried out by a rather complicated system, starting with the president and board of directors, with perhaps an executive committee and departmental heads, followed by manager, sub-managers, superintendents, and foremen, and it is due to this ramification and division of authority and responsibility that great wastes, not usually considered or in general not noticed, creep in; and it is against waste due largely to the lack of proper functioning of the organization mentioned that this paper is directed.

The ordinary wastes about a mine are ever present and are too well known to anyone in charge to warrant more than passing notice here. They are in connection with excessive or improper use of powder, leakages of air, loss of tools, lack of care in keeping up repairs, insufficient trackage, improper planning resulting in too few working faces for the tonnage desired, poor service for transport of men into the mine and to faces, insufficient ore bin capacity, resulting in tie-up of tramming, poor light, lack of supplies and poor delivery of same, and bad supervision, to say nothing of choice of inadequate and inefficient machinery.

In the case of steam-shovel mining, in addition to some of the above, wastes occur due to lack of motive power, tracks, preparation for and blasting in advance, proper facilities for repairs, and for delivery of fuel, water, etc.

To insure the proper operation of a mining corporation of considerable size, there should first be a board of directors, made up of men of energy, high standing, and business ability, and they, and especially the president of the board, should be able to give the business the attention it demands. The acts of this body should, in the main, be legislative rather than executive. It should pass on the policies of the company, attend to the finances, and keep in touch with the actions of the manager, who should be the administrative head and be held absolutely responsible for the conduct of operations. The duties of the president of the company are, also, more or less executive in nature in his dealing with the manager, and with outside interests, such as legal and financial.

For quick action, an executive committee of the board is often advisable, but it should in no way usurp the administrative or technical duties of the manage-

* Address at joint meeting of Mining and Metallurgical Society of America and American Institute of Mining and Metallurgical Engineers, Feb. 22, 1922.

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ment. The great trouble in administrative work by a committee is the dodging of responsibility through the spreading out of authority and the feeling that praise or criticism would be divided; also, in the case of criticism, the feeling that it would be passed on to the management.

A bad start by the board of directors at the beginning in the way of poor financing, bad planning, etc., may cause such waste as to handicap a venture, in spite of a good management that may be in charge of the operations.

The board of directors, after choosing their manager, must place their full confidence in him and back him up to the fullest extent. If confidence in the management is weakened or destroyed, a change should be made immediately, for even a good manager cannot "carry on" to advantage where there is a lack of trust, and under such circumstances a change would be best for both the directorate and the management.

As it is found necessary to have financial auditors to verify accounts, so should there be occasionally an independent technical audit of the administration of operations by some expert, not because there is a lack of trust in the management, but as much as anything else to prove that the board's approval of its manager is properly based. Such technical audits have been rare in the past but are of great value. Too often it was taken for granted that operations were being well managed if the returns were satisfactory, and on the other hand that if the returns were poor necessarily the management must be poor.

Trust and faith in the management is the essence of coöperation between the manager and board of directors, and without coöperation no really good work can result.

## Financing

Censure for an unsuccessful or badly managed operation is too often placed upon the manager, when in fact the fault lies in the home office. Under-financing and over-financing are often to blame. Under-financing makes it impossible to carry out necessary improvements looking toward the elimination of waste due to low extraction, or to wornout or antiquated machinery, such a course resulting in not only non-conservation of resources but also smaller profits than the proposition deserves.

Often, too, with a company that has been operating successfully for some time, the directors are unwilling to lay aside funds for improvements, insisting upon keeping up dividends or adding to them.

Over-financing may result in waste from too heavy overhead costs for interest, to the installation of a plant too large to be warranted by the size of the property or to the impossibility of working it on the scale that the plant calls for. Most of us have seen the building of smelting or treatment plants for mining operations before the ore deposit has been proved, and such wasteful use of funds has by no means necessarily been done for stock-jobbing purposes, but simply on account of poor business judgment.

## Equipment and Overhead

Waste in connection with equipment is to be considered in a paper by Mr. Ingalls, so I shall not dwell on that phase any further.

The refusal to sufficiently equip is often equally disturbing. What could the low-grade porphyry mines accomplish if attempts to equip and operate them on a scale of less than a thousand tons a day were made? Their success has been due to large-scale operations, without which many of them had already proved failures.

Refusal on the part of the directors, although advised by the management, to install for the treatment of gold ores a cyanide plant; or in the case of many copper, lead or zinc ores, an oil flotation plant, has resulted in much loss due to low extraction and consequent loss of added profits.

The board of directors is to be blamed for increasing unnecessarily "overhead" due to extravagance in office expense, head office staff, employment of unnecessary experts, expenses in travel, etc.

## Employment of Experts

While the employment of experts in certain special lines is often most desirable, it is frequently unnecessary and wasteful. Except in the case of a technical audit, reports by such experts should be made directly to the manager for his consideration and advice.

Too often the expert makes his recommendation on his own particular specialty, without considering the effect on other dependent operations. The dovetailing of the different operations and making each one serve its purpose towards the achieving of the best results is one of the principal functions of the manager.

We know of so many instances where the improvement in costs and increase in savings in one department has been at the expense of others, and where the loss in other departments has been much greater than the gains in the first, and here we can see the bad features of dividing a business up into departments which report directly to the directors rather than to the manager—the head of each department trying to accomplish the best results for his own section and not giving due consideration to the others, all heads being ambitious, having knowledge of their own work, being anxious for the success of the organization, but working as independent units and not being in a position to merge the more or less conflicting interests.

Instances have been known where enormous expenditures have been made in deference to the suggestions made by experts, in which most elaborate plants have been installed, such plants being laid out far in excess

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of the needs for other operations on which these were dependent. This illustrates a lack of coöperation and a lack of sufficient power given to the management to properly dovetail the different requirements so as to produce a more homogeneous whole.

### Decision as to Size of Plant

One of the most important questions, and for which the directorate is very largely responsible, after receiving trustworthy advice as to the size of the orebody, probable operating costs, etc., and recommendations as to size of plant and physical possibilities of operating, is to decide on the size of the installation in order to obtain for the stockholders the greatest profit, and in this connection the so-called "present value" has to be considered.

Other things being equal, it is possible to make practically the same total operating profit if a property has a life of one hundred years as when the plant is installed for working out the orebody in thirty years, but in the case of the shorter life the "present value" far exceeds that of the more extended operation.

On the other hand, a plant may be installed so large that the extra expenditure to be incurred may make the "present value" less than in the case of a smaller plant.

Assuming a property having 400,000,000 tons of ore developed, on which $2.50 per ton operating profit could be made with metal at an average price; the "present value" of the ore developed would depend on the size of the treatment plant. The following table shows the great difference in the "present value" of such a property with different assumed plant capacities, all other factors being the same:

| Daily Plant Capacity | Life of Property | Annual Operating Profits | * Approx. Present or Actual Value |
|---|---|---|---|
| 10,000 tons | 111 yr. | $8,750,000 | $109,000,000 |
| 20,000 tons | 55½ yr. | 17,500,000 | 209,000,000 |
| 30,000 tons | 37 yr. | 26,250,000 | 292,000,000 |
| 40,000 tons | 27¾ yr. | 35,000,000 | 359,000,000 |
| 50,000 tons | 22¼ yr. | 43,750,000 | 411,000,000 |

It will be seen from these figures that in cases of mines with great ore reserves, there may be great losses to owners if plant capacity is not great enough. Also, that cost of increased plant would be small as compared with increased value obtained.

### Indecision

Among the common faults of a board of directors, which cause loss and waste, may be mentioned indecisiveness and vacillation, which tend to discourage the manager and his staff, and often times mean great delay and the expenditure of unnecessary funds; also lack of careful consideration before making decisions as to method of operation of changes in plans leads to waste. Cases have been known in large operations where the question of method of mining was under consideration for six or seven years. First, it was decided to carry out one method; then it was held up; again decided; and again held up, much to the detriment of the operations, which should be planned several years in advance and carried on with some definite object in view, the lack of which not only upsets the organization but, if a change is finally made, will have resulted in considerable loss. It goes without saying that propositions should be carefully considered, looked at from all possible points and discussed freely, but after this has been done decisions should be quickly made and lived up to.

Frequently, too much time is taken before deciding on methods, or plant design, or changes in same, and too much conservatism is shown in unwillingness to change antiquated methods and spend money for improvements.

### Unnecessary Detail

It is necessary to mention a not too infrequent trouble and expense resulting from the often inconsiderate request by directors for complete plans and estimates, and for numerous and very detailed reports on certain phases of the operations. I have known of hundreds of thousands of dollars being wasted on account of demands for plans and estimates for plants of different capacities, where the general questions under consideration in no way required any such elaborate details at such great expense. It is indeed wise that the directors should be kept fully informed, but the continual request for information in detail, which requires the collaboration of different heads of departments and takes them away from their operating work, is not desirable. It is often due to the thoughtlessness of directors and non-appreciation of the work entailed, but when carried to an extreme it is a wasteful and disturbing method.

### Non-interference

Too much emphasis cannot be placed on the non-interference by the board of directors with the operating management; nor should the board of directors try to influence the manager in the appointment of his staff or employees.

There are a number of splendid examples, in this country, of the proper functioning of boards of directors and managements, and to such coöperation has been largely due the great success of the undertakings.

### Loss and Waste due to Manager

The possibilities of losses and waste due to executive or administrative control are so great that the choice of a man for the position of manager must be made with the greatest care, and, regardless of suggestions or advice from experts or consulting engineers, the responsi-

* Note.—Present value figured on an 8 per cent. dividend basis and on the amortization fund being reinvested annually at 5 per cent.

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bility for the control and operation of the mining property must devolve upon him.

It goes without saying that the manager should be honest, industrious, intelligent, energetic, able and with initiative and a sense of responsibility. He should know how to select and handle men, how to instill loyalty into the organization, and how to keep up with the advances in improvements. He should above all have a technical and commercial knowledge of mining. The choosing and the responsibility for such choosing of departmental heads should be left to the manager, and those departmental heads should be directly responsible to him for their organizations, and for the superintendents, foremen, etc., under them.

The feeling of responsibility should be appreciated all along the line. The question of loyalty and esprit de corps is most important, and it should be understood that loyalty to the chiefs should mean at the same time loyalty to the company as a whole.

While the manager should be able to understandingly supervise and correlate all the departments, he should also be able to so use his staff as to make it possible to give a general supervision of the operations as a whole, and not be tied down by such detail as would tend to swamp him. There are many managers who in small operations prove excellent, but because of not being able to delegate authority, prove almost worthless where such operations become extended.

As far as the direct management is concerned, as a general rule the larger organizations are being handled by high-grade technical men of great ability and experience, whose operations have been conducted with great efficiency. In fact, many of these men might be considered efficiency engineers in the true sense.

In commenting on the question of waste, the Committee on the Textile Industry of the Committee on Waste in Industry, makes the following wise statement:

> The placing of the responsibility for waste, however, is in some respects the least important phase of the problem. The causes of waste and their elimination are the vital elements of the situation. If they can be determined, in some degree at least, and ways and means found to overcome them, then this investigation may be said to be truly worth while from a constructive standpoint.

It is ever the problem of the manager and his staff to find out where the wastes are and to determine some method for their elimination.

Among the causes of waste in management may be mentioned indecisiveness and vacillation, also mentioned in the case of the directors.

## Methods of Mining

Great losses may occur through the choice of a method of mining not best suited for the orebody in question, and on the proper choice may even depend the success or failure of the operation. Decision has to be made in the case of large orebodies as to whether steam-shovel or underground methods should be employed for the extraction of the ore, or as to which one of several caving methods should be introduced—whether top-slicing, sub-level, or block-caving, or modifications of the latter, such as shrinkage stoping and caving of the pillars; the Ohio system, or some one of its modifications, such as the Ruth, Miami or Gastineau.

With a low-grade orebody of great size, other things being equal, the lower costs of a method like the Ohio, or some one of its modifications, would more than counteract the loss of ore due to the admixture of waste and ore that is bound to result from the use of this method.

In the case of a higher grade ore, though entailing a greater mining cost, the choice of the sub-level or even the top-slicing system might be advantageous, because of increased profits due to less admixture of ore and waste, and to the reduction in loss of ore which results from the employment of either of those methods.

In the case of flat veins, choice has to be made of the longwall or pillar-and-stall systems; or in the case of veins of considerable pitch, the question of back-stoping, underhand stoping, shrinkage stoping, filling or square-setting, or other styles of timbering, has to be decided, and on such a decision much depends.

## Plant Design

It is always a temptation on the part of a manager to have as fine a plant as possible, not only for accomplishing good results but for appearance as well, and over-expenditure in equipment and plant has to be guarded against. He has also to guard against the requests and demands of department heads for improvements in their special lines for the same reason, and must carefully weigh the recommendations made by heads for outlay intended to diminish costs or improve extraction in their special departments, especially if such reduction in costs produces greater costs in other departments; or where it is a case of obtaining greater extraction, he must see that the cost of obtaining this is not greater than the profits accruing by such changes. While the desire to increase extraction and decrease costs of operation is always laudable, still there is often the danger of the capital outlay being greater than the saving resulting. In other words, often the operating costs in obtaining such improved extraction are greater than the value of the increased extraction.

Very often figures are given which prove that by the introduction of additional machinery or of a new process, the extraction can be increased, and the fact is lost sight of that by so doing the profits would be decreased rather than increased, or that the additional saving would not cover the cost of the installation.

The question of the location of the different plants for carrying out the operations has to be carefully considered. It is well understood that, as far as possible, the different plants should be placed close together, but questions of supplies, water, space for

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plant, transportation, etc., often make it necessary to have the mining operations carried on at one place, the concentration at another location, and the smelting at a third, and it is in deciding upon these points that the management, whether it is the manager himself or the consulting engineer, who may have charge of the preliminary design and laying out of the operation, must be most careful.

Instances have been known in which, if only the concentrator were considered, the lowest costs for concentration would be obtained by placing this plant at a certain location, but when the transportation of the ore to that place was considered, it was found much more economical to place the plant near the mine.

On the other hand, favorable transportation costs with the concentrator near a water supply would make it advisable to locate the concentrator or smelter at some distance from the mine.

The departmental head, left to himself and thinking only of his own costs and advantages, would be inclined to consider his own particular problem by itself, rather than as a question of the whole.

### Losses Due to Choice of Methods

We all know the great advances made in concentration due to oil separation. On the other hand, we also know that the use of flotation processes on some ores at certain properties, while it has increased the extraction, has done this at a cost greater than the extraction warranted, and that in so doing waste in profits has resulted.

Backwardness or over-conservatism on the part of the management in recommending improvements has resulted in operating at a loss in extraction and profits that is unpardonable.

A great temptation to any management is to reduce costs, and to do so is a laudable ambition, but the attempt often results, as will be shown, in a reduction of profits instead. For instance, in the mines of the Rand near Johannesburg, in South Africa, the gold occurs in reefs of varying thicknesses. Within certain limits, the wider the reef or the greater the thickness of ore mined, the lower will be the cost per ton of ore extracted. On a five or six foot reef, other things being equal, the cost per ton of ore extracted is lower than in the case of a reef of nine or ten inches. The narrow reef is, however, as a rule very much higher grade per inch of thickness than the wider reef, and for the best profits it is advisable to stope as narrow a working face as possible, for the reason that while the material outside of the reef itself is almost barren and that one can sort out barren waste pieces, still in the breaking of the waste much of it is too fine to be picked out and necessarily goes into the bins with the ore, thus diluting the latter and not only adding to the tonnage that it is necessary to mill, and therefore adding to the cost per ton of ore, but also resulting in lessened extraction due to the fact that as a rule the tailings from the combination of waste and ore will run very nearly the same as would be the case with the treatment of the higher grade product.

The mining, however, of this narrow vein is more costly, and therefore on the books it shows that the cost per ton of ore mined is higher than in the neighboring property containing the five or six foot reef. The tendency of the directors is to hammer the manager and insist that he mine as cheaply as his neighbor, and yet in carefully sorting and mining as narrow a face as is compatible with proper working, the manager is carrying out the work to better advantage to his directors and stockholders than if he tried to make an individual record of low costs in mining. This pressure on the managers has been very great and many give way to it because of the continual criticism, and perhaps due to direct orders, in spite of the manager's explanations of the advantages and greater profits to be derived by the method carried out by him.

Another illustration might be given in the case of the development of low-grade copper ores, where in addition to ore of good grade, much larger tonnages of low-grade ore, either on the edges of the deposit or in greater depth, have been encountered. This latter ore, when averaged with the higher grade ore, would show a tremendous tonnage of payable ore, but a large part of this tonnage would hardly be payable and would add little to, if not lower the "present value." The mixing of such tonnage with more profitable ore would either require a much larger plant, or with the same plant would result in lower annual profits than would have been received had the better grade of ore only been worked.

Still another illustration might be given in connection with underground mining of a very wide deposit, in which the more profitable ore was on the hanging wall side and gradually decreased in value into the foot wall, until it fell considerably below what was considered of "pay value." Physical conditions prevent the very great enlargement of the plant. With a plant of the size proposed the time necessary to extract the ore would be nearer a hundred years than it would be fifty. It would be possible to extract the ore from the hanging-wall side and make great annual profits, and to leave most of the ore in the foot-wall side to be extracted at some future time, after, say, fifty years.

The inclusion of the low-grade ore with the high-grade would show a very great tonnage of recoverable copper, and yet the mining of this would give the stockholders during the next thirty or forty years very much smaller profits than would be obtained if the operations were concentrated on the better grade ore.

On the other hand, we know of many mines where "selective" mining has been carried on to the extent of what is called "gouging" or "picking the eyes" out of the mine. In so doing, ore is left of lower but still good grade which could have been mined at considerable

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profit, but which so far as the future is concerned is practically lost. We also have many instances in old mines in Mexico, in which ore which was at that time profitable under the method then employed had been extracted, but the ore left, and which could not be profitably treated under the methods then in vogue, can now be extracted under improved methods, and many old fills and portions of then unprofitable veins are now being mined. The former workers were not in error in leaving such material, because it would not have given a profit to them at the time.

### Not All Waste Reprehensible

Another illustration of waste which was not altogether reprehensible was the mining and concentration of zinc and lead ores in the Joplin District thirty years ago. At that time, the camp was a "poor man's camp" and prospecting was done with little or no capital. If ore was found, it was first treated at a low extraction with hand jigs, and later perhaps a small concentrator was erected. None of the mines was large enough to warrant expensive plants or the installation or operation of machinery for higher extraction. For these small companies a concentrator built with the necessary provisions for a high extraction would probably not have enabled the original owners to come out even. The deposits at that time were small and erratic and it was better business, though not highly commendable as a conservation measure, to run with high losses rather than with higher extraction, with the aim of greater profits in view.

Many managers are too prone to try new methods without their being thoroughly tested out. A desire to improve is certainly to be commended, but care must be taken not to rush in too soon. On the other hand, too great conservatism is to be deplored.

### Progressiveness but not Overdevelopment

It is within our experience that there are companies which have been models of progressiveness and have been leaders, and which have grown complacent and satisfied to let well enough alone. This continued so long that they fell into the rear, until by some shock their eyes were opened, as for instance by knowledge of the great strides made by some other mining companies, causing the former to wake up and to introduce needed improvements and renew the progressive movement. Another reason for the discontinuance of a progressive course is the feeling on the part of the directors that a great deal has already been spent for improvements and that a halt should be called, and natural inertia makes difficult the return to motion or advance.

Losses or wastes often result from over-development. It is a great satisfaction to any manager to have a knowledge of what is before him, of the tonnage that may be expected to be available, and to be able to average his ore rather than to have periods of high-grade followed by periods of low-grade ore. Where an amount of ore has been developed in excess of requirements, a further opening up of ore becomes more or less of a luxury, being unnecessary and requiring considerable expenditure far in advance of requirements.

In the case of many vein mines, however, where the ground is soft or heavy, such for instance as the mines around Bisbee or Butte, and where the development is done mainly by drifts, crosscuts and raises, it would not be the part of wisdom to over-develop, because of the cost of keeping open the drifts, on account of deterioration of timber from rotting or crushing. The cost of keeping up this work far in advance would be greater than the advantages obtained.

In the case of iron ores or the low-grade porphyries, where the testing of the orebodies can be done by churn or diamond drills, it is very often desirable to determine the limits of the orebody in order to decide on the proper sized plant for the treatment of the ore at the best speed that financial or trade conditions would warrant, but even here development can be carried further than necessary and in too much detail, resulting in excessive expenditure.

### Accounting

In determining and avoiding waste, besides constant supervision and testing, careful and very detailed accounting is required,—much more elaborate than that required for annual financial statements and balance sheets. Without such close accounting the question of leaks or improper operation often becomes a guess and results in numerous debates difficult of determination. We have what we call bookkeeping or cost accounting for the management, and bookkeeping for the home office. Except for the conclusions, the bookkeeping for the management is too voluminous and exhaustive for the home office, and the accountants of the home office often object because of what to them appears unnecessary detail.

Of great if not equal importance to the cost accounts and technical records are the sampling and metallurgical records.

For a manager who will really study the cost sheets, the details are necessary and illuminating, for they allow him to place his finger on weaknesses that would otherwise be difficult or impossible to detect.

### Size of Staff

Research work must be kept up, in order to discover losses in extraction or operations and to improve conditions. Such work can be overdone and its cost exceed the gains, but it should be carried out in reason, and even on a small scale should reap valuable results.

In the actual operations the great considerations are loyalty, coöperation between the departments, teamwork, and a feeling of trust on the part of the

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employees due to fairness and sympathy on the part of the management. The great destroyers of good work are jealousy, ambition for self at the expense of others, and a feeling that someone else's gain is your loss.

The temptation to have too large a staff is often great and should be avoided. At the same time, it is dangerous to cut it down too low. One of the great difficulties in any organization is to build up a force in which there are understudies for all the important positions. The old Cornish superintendent was always afraid that a good man might displace him and step into his shoes, and this feeling is common with a great many managers and heads of departments today. A manager may feel a little more secure in his position if he has no understudy, but it is not for the best interests of the company. He should make his men feel that he is looking after their interests, and he should arrange for the promotion of his own men, either in or out of the organization, as rapidly as possible.

A very common trouble with old-time managers has been the using of machinery or methods of their own design or invention, rather than the adoption of better methods designed by someone else. Another common failing on the part of managers is the overdesire to be popular with their men and to allow too many perquisites to the employees, which unnecessary allowances are quite often next to impossible to abolish and result in not a little loss to the company. The abuse of such privileges almost always leads to trouble.

### Stocks of Supplies

One of the great causes of loss in carrying on operations is the temptation to carry too large stocks of supplies, and this temptation becomes greater as the distance from market increases. The carrying of heavy stocks of supplies locks up funds unnecessarily, and results in having too much dead stock on hand as changes or improvements in methods are introduced. It is indeed a dreadful thing to run out of necessary material and have to stop any part of the work that is essential. It is often thoughtless and unreasonable, however, on account of the fear of this to carry too heavy stocks.

### Loss of Time Through Shutdowns

Loss of time through shutdowns is the bugbear of any mining operation, and causes losses that are often difficult to gage. If a shutdown becomes necessary for a short time, many costs, such as overhead, continue—water has to be pumped perhaps, machinery kept in order, watchmen on the job, and interest and salary charges are ever present. If the shutdown is for a long time, it may mean the dissipation of employees, and later the gathering together of new men and the building up of a new organization, making the "turnover" more costly even than the ordinary during the operating period when a "turnover" of greater or less extent results from the discharge or voluntary leaving of some men. This labor "turnover" in any business is a very serious matter and adds greatly to costs.

In starting a new mining camp, such "turnover" reaches the maximum, for the "floaters" come in from all directions and it takes some time to accumulate a permanent lot of employees.

Shutdowns on account of labor troubles are frequently the cause of great loss. They may be brought on by the employees themselves, or, as is frequently the case, by outside labor organizations entirely, but in districts not under the control of labor unions the personality of the manager often prevents such difficulties, for in mining as in any other business personality is a great factor.

### Controllable and Uncontrollable Shutdowns

Shutdowns due to lack of orders or inability to dispose of the product are beyond the control of the local management. This is largely a financial matter and one to be determined by the board of directors. For instance, in the copper and zinc industries especially, it has been found necessary to shut down many properties or to curtail the production in others. The wisdom of this in many cases is subject to debate. In a property which cannot sell its product at a profit, a shutdown becomes necessary, unless it is thought that an increase in price sufficient to permit profitable operation can be expected within a short time. Even during a shutdown expenses are great and considerable loss results, for there are always overhead charges to be considered.

The shutting down of properties which can, even at a very low price, produce at a profit is a questionable one, for besides the cost of the shutdown and the difficulty and expense of gathering together a new organization when starting up, there may rightly be considered the loss due to no profits. It is a very questionable matter whether it is best by restriction of production to try to keep prices up so that high-cost producers can operate, and, in order to do that, have the low-cost producers shut down or curtail their operations. This is especially so with properties which have such large orebodies as to insure a very long life. Such a loss of profit is like a lost opportunity, not to be recovered, at any rate not during our lives. Is it best for the industry and for the state that such an artificial condition be permitted, which would allow the high-cost producer to operate when the low-cost producer can supply the demands of the public and at a reasonable profit to himself? I doubt it.

In connection with shutdowns, I have not considered the question of seasonal operations common in the coal and iron mines, or of placer or dredging operations carried on in regions of severe cold.

Steady and continuous operation of mines, mills, and transport service between the two, is the basis for

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successful working. A delay in one department because another cannot receive the ore, or on account of bins being filled, or because of a lack of ore, increases cost and upsets organization. There must be a proper balancing and correlation of operations.

### Transportation

The question of the price for transportation by railroads is an important one, and one in which it is often possible to avoid great losses, either by careful routing, proper classification, or by a special arrangement through the federal or state railroad commissions for special consideration. In the old days much could be done in the way of working one competing line against another to lower railroad rates. This is still possible with water and other means of transportation. Even with the regulation of railroad rates at the present time, the question of transportation is so important that many of the large corporations have their railway departments to take charge of proper routing, tracing, etc. Where shipments are large and continuous, the question of getting cars is an important one, for without a proper and steady supply the mining operations cannot be carried on to best advantage. Any interruptions in the regular operations, through delays from whatever cause, are always costly, and this is especially so where, owing to the large scale operations it is not possible to keep large stock piles or ore bins, and dependence is placed on the continual supply of cars for the disposition of mine products. This applies particularly to the mining of coal and iron ore, and to a less extent to the shipment of concentrates or sorted ore. In the case of the low-grade porphyries the shipment of the raw ore is usually over the company's own railroad.

### Purchase of Supplies and Sale of Product

A common source of loss is in the purchasing of supplies. With large corporations this is placed in the hands of a purchasing department, whose sole business it is to keep in touch with markets and make the best bargains possible, but for proper work coöperation of the management is very essential. The tendency of the purchasing department is to buy as cheaply as possible, some times at the expense of quality or efficiency, and also to buy in larger quantities than may be warranted. On the other hand, the manager may hamper the purchasing agent by calling for goods of a special make when others may be equally acceptable, or he may too greatly limit his specifications.

With small properties, however, the manager may have to be his own purchasing agent, and he is often at a disadvantage because of being distant from cheap markets, buying in small quantities, or being interested in direct operating and technical problems rather than in strictly commercial matters. Pressure too, which, however, should not be given way to, is often brought to bear by directors or other stockholders to favor certain firms, who take advantage of such preference. It is because of such practice that the law against interlocking directorates has been found necessary.

Great losses often occur in selling the ore, concentrates, or metal produced. Large corporations have their own selling departments, conducted by experts in the business, who watch the markets and keep in close touch with the consumers; or arrangements are made by the directors with selling agents, whose business it is to watch the markets and make the best arrangements possible.

In the case of a mine whose product is metallic gold, there is no especial difficulty, as the United States Government is the purchaser at a fixed price. In the case of ores, however, it is often necessary to contract with a smelting company, and the arrangement of such a contract requires great skill and knowledge on the part of the management, for the reason that there are so many different bonuses, penalties, various smelting charges, etc.

The system of purchasing non-ferrous metal ores by the smelting companies is unnecessarily complicated, and because of this not fair to the inexperienced miner.

### Summary

To sum up: in addition to the usual well known direct sources of waste in mining properties, and for which the management on the spot is responsible, there are even losses that may be traced to either the board of directors or to the manager, or to both, and such losses and wastes are in the main due to lack of or improper financing; excessive overhead; indecision in action; over-conservatism; unnecessary detail or lack of it; interference with management by directors; poor selection of method of mining; poor plant design; lack of proper touch with the business through poor costkeeping and poor technical records; inefficient purchasing of supplies; poor salesmanship in disposing of product, or negotiating smelting contracts; and last, but not least, losses due to lack of proper coöperation between directors and manager and between manager and staff and employees, for in the final analysis success in management is absolutely dependent on teamwork and the earnest, intelligent and loyal efforts of all concerned, from the directors to the lowliest employee.

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## Conference on Commercial Engineering

THE United States Commissioner of Education is calling a second public conference on commercial engineering on behalf of a committee appointed by him to investigate business training of engineers and engineering training for students of business.

The conference will be held May 1 and 2 at the Carnegie Institute of Technology in Pittsburgh and will be open to the public.

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# Elimination of Waste and Improvement of Efficiency. What are the Economic Fundamentals?*

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THE main objective of everybody, individually and collectively as the people of nations, is to earn their living and improve the scale thereof as much and as rapidly as possible. We are able to earn our living only by working and producing. We are able to rise to higher standards of comfort only by increasing our production of goods, or diminishing the waste of those that we do produce, or both. This statement is trite. It is equally trite to dwell upon the importance of increased production to be derived from increased efficiency of labor and improved management; and the good results that would accrue to everybody if employers and employees would work together to secure the maximum of production at the minimum of cost. All of this is nothing more than platitude, to which every intelligent person subscribes in the abstract; but what concerns us especially, and what is neither so easy nor so understandable, is to translate the expression of the abstract principle into formulas for action.

The national net income obviously may be increased in two ways, or by both together. One is to diminish the waste of the goods that we already have made available. The other is to increase the supply of goods. Increasing the supply of goods may involve the elimination of waste, but a distinction is to be drawn between the waste of things that we have and the failure to obtain those that we might have.

If we limit the term "waste" to the careless and profligate use of the materials that have come into our possession, together with the absorption of labor in doing obviously unnecessary things; and if we characterize by the term "inefficiency" the failure to accomplish in our industrial operations the best of which we are capable, we shall create a distinction that will be promotive of clear thinking. In this paper I am going to deal with inefficiency, not waste, observing the distinction, arbitrary if you please, that I have made.

Without any doubt the greatest inefficiency that exists in our economic affairs is that which causes hundreds of thousands, perhaps millions, of men to be idle a good deal of the time. The major reasons for such idleness are two-fold. One of them is the consequence of what for convenience may be called business cycles, although I do not hold to the hypothesis of business cycles as it is now being rather widely expounded. That hypothesis involves the idea of rhythmic undulations due to causes unknown, but which it is hoped may be ascertained. The movement of business in waves up and down is undeniable, but that there are recurrences of cycles every so often is purely imaginary, I think. It is unnecessary to digress into that subject. The extents of the rises and falls above and below a median line undoubtedly is less than is commonly supposed.

## Normal Percentage of Employment

In ordinary times of good business there is a certain number of workers attached to our industries of whom perhaps 95 per cent. are occupied, the other 5 per cent. being idle partly from disability, partly from choice, for there is always a considerable number of workers who are habitually idle. Let us suppose that for one reason or another there develops an increase in the demand for goods and services, the percentage of employment may rise to 98, which would correspond with the conditions of a boom. During the war we went much farther than that, for with about five million men transferred from industry to the army and navy we compelled all of the habitually idle to go to work and we induced a larger proportion of women than ordinarily to enter industrial employment. On the other hand, if the percentage of employment should fall from 95 to 92 we should have the conditions of dull times; if the percentage should fall to 90 we should have great depression, accompanied by a good deal of hardship.

The figures that I am using are intended to be illustrative, rather than precise or even approximate, for in fact there are scarcely any statistics illuminating this very important subject. However, we may check up by reference to some of the scanty data. The year 1914 was one in which our industrial conditions changed

*Address at joint meeting of Mining and Metallurgical Society of America and American Institute of Mining and Metallurgical Engineers, Feb. 22, 1922.

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from normality in the first half to depression in the second half, following the outbreak of the war. The number of factory workers in that year was about 7,500,000. In the month of maximum employment about 96 per cent. were at work; in the month of minimum employment, about 90 per cent. In 1921 we probably had about 42,500,000 workers, of whom about 6,500,000 were farmers, and about 1,000,000 were in governmental service, leaving about 35,000,000 in other occupations. The maximum estimate of unemployment was about 5,000,000, which would indicate about 14 per cent. idle.

Nobody appreciates better than myself the imperfection of these data, but I think that they are near enough to bring out the point that I am trying to make; namely, that the range between the zenith of industrial activity and the nadir of depression is comprised within a rather small percentage of the total number of workers. Diminution of this range, or rather diminution together with elevation of both the high and low points would spell increase in both economic efficiency and social happiness. Such an improvement is not outside the zone of reason.

We have another kind of inefficiency, which may be more important, though I hesitate to make a comparative statement about conditions that can not be measured, or have not yet been measured. I refer now to industries which are so badly organized, or which function so badly that the workers engaged in them, or attached to them, are able to work year after year for only a fraction of the time possible, irrespective of whether the general state of industry be feverish, normal or depressed.

The most noteworthy examples of such industries is bituminous coal mining, wherein the average annual employment is only 200 to 250 days per annum. There are about 700,000 men employed in bituminous coal mining, compared with about 150,000 in anthracite, wherein the labor conditions are much better. The building industry, which employs about 3,000,000 workers, garment manufacture and boot and shoe manufacture are also major industries that are characterized by short-time work every year. In boot and shoe manufacture the number of persons attached to the industry is about 225,000; in garment manufacture about 375,000.

According to the report of the Committee on the Elimination of Waste in Industry of the Federated American Engineering Societies, the average clothing maker is occupied for only 69 per cent. of the year (300 days); the average shoemaker only about 65 per cent.; the building-trade workmen only about 63 per cent. Other industries will be found no doubt to exhibit similar conditions. On the other hand, there are industries wherein the workers ordinarily find full time employment. Thus the copper, lead and zinc miners of the country commonly work from 300 to 310 days per annum, these branches of metal mining being well organized and excellently functioning. The men engaged in transportation, about 2,250,000 in number, experience little or no inability to work.

Among the industries that are characteristically of short time nature, in contradistinction to full time, it will be found that they are subject to the vicissitudes of the weather, to the vagaries of fashion and to the obligations of seasonal conditions. The builder is especially the victim of the weather. We may perhaps plan the prosecution of such work better than we have been doing, but nothing can obviate the fact that building is largely out-of-doors work and can not be done so well in the winter as in the summer. The clothing and boot and shoe trades are essentially seasonal and subject to the whims of fancy and fashion. We may argue that this ought not to be so, but our arguments will be futile so long as we ignore the human nature which makes them so. Anthracite coal mining is inevitably subject to seasonal conditions, just as is building, for we need more of that coal in the winter than at other times of the year. We may counteract this condition by maintaining production and putting coal into storage during the period of dull demand, which is in fact done on a large scale, but this does not meet the economic condition that the proper place for storage is where the coal is going to be used and our homes are not generally built with bin capacity for holding a winter's supply of coal.

### Producing Industries Overbuilt

However, we can no doubt by the exercise of thought and the improvement of industrial organization mitigate the evils resulting from seasonal conditions and by such mitigation increase the regularity and time of the work of the persons attached to these industries. But there is another cause of short-time work that has not heretofore been dwelt upon sufficiently although it is an underlying cause and may perhaps be the most important of all. This is over-capitalization, and by that expression I do not mean financial over-capitalization, but rather physical. Another expression meaning the same thing is that our producing industries are characteristically overbuilt. At the present time the overbuilding is stupendous, largely as a consequence of the war.

I have gone into this subject broadly in my book* on the "Wealth and Income of the American People." Here I shall do no more than summarize the position of the major mining and metallurgical industries as they were at the end of 1920, remarking that the position at the end of 1921 was not materially different.

In iron and steel we have a blast-furnace capacity for the production of 48 million long tons of pig iron per annum. The steel works have an ingot capacity for 52.5 million tons according to some authorities, 55 million according to others. The steel-plate rolling

*G. H. Merlin Co., York, Pa.

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mills are rated at 6,700,000 tons and the sheet mills at 4,000,000 tons. The maximum pre-war production of pig iron in the United States was about 31 million tons and of ingot steel about 30 million tons. At present the capacity for pig iron, ingot steel and both plate and sheet is far in excess of any prospective requirement.

The capacity for copper production is without any doubt greatly overextended, but it is difficult to express this numerically as to the mines. They produced about 1250 million pounds in 1913 and about 2000 million at the maximum (in 1916). At the latter time their production was forced to a rate that probably could not be maintained long. The present mine capacity is probably somewhere between 1500 and 1800 million pounds.

Our copper smelteries, not including those of Lake Superior, have capacity for treating about 22½ million tons of ore per annum, but the quantity smelted in 1916 was only about 11¼ million tons. Our electrolytic refineries can turn out about 2750 million pounds of copper, while the Lake Superior works, the producers of Bessemer copper, etc. can easily give 250 million pounds in addition thereto. Of course our refining business is organized on the basis of treating a great deal of foreign material, but even so the present capacity is greatly in excess of any prospective requirement. Our copper wire, sheet and brass mills have present capacity for the manufacture of about 2000 million pounds of copper per annum, but the use of copper in the United States immediately before the war was only about 800 million pounds per annum.

Our silver-lead smelteries are capable of producing 560,000 tons of lead, while the non-argentiferous smelters are capable of treating 557,000 tons of galena concentrates per annum, producing 342,000 tons of lead. The maximum pre-war production of lead was 436,000 tons. The silver-lead smelting capacity is not really overbuilt to the extent that these figures indicate, for there is included a good deal that has become obsolescent by geographical changes, *i.e.*, failure of tributary ore supplies.

Among the lead manufacturers there is an excess of capacity, both in the white lead and blue lead divisions, an excess although the blue lead plants (sheet, pipe, shot, alloys, etc.) are reckoned only on the basis of one shift per day; if there be need, their operations can be doubled to a large extent.

In zinc there is huge excess both in mining and smelting capacity. The smelting industry, after discarding some of the ephemeral war plants, still had good capacity for producing 800,000 tons of spelter per annum. The maximum pre-war production of spelter was 353,000 tons. However, a large part of the present surplus of zinc smelting capacity is destined to be extinguished soon, if it has not been already, by the conditions of natural gas supply in Oklahoma. The zinc oxide plant of the country is not materially overbuilt if the automobile tire business should hold to its maximum, but that is pretty doubtful, and probably we shall discover that there is some excess above the coming requirement.

Our anthracite-coal mining industry is not materially developed beyond the requirements, if we may rely upon our coal-mining colleagues, but they tell us that the bituminous mines can do twice what they are likely to be asked for. Some recent testimony before the Committee on Manufactures of the U. S. Senate showed that in 1920 there were about 11,000 coal mines in the United States, controlled by 7000 operators, whereas in 1913 the total number of operations was only 5776. According to a recent estimate by J. D. A. Morrow, the present capacity of the bituminous mines of the United States is about 776 million tons. In 1913, they produced 478 million.

In brimstone the country has capacity easily to produce 2,000,000 tons per annum, with prospective demand for no more than 1,000,000 tons. In 1913 we made 2,235,000 tons of sulfuric acid (basic 100 per cent. $H_2SO_4$); in 1918, no less than 4,700,000 tons, and at the end of 1918 we had capacity for 6,000,000 tons. The maximum pre-war capacity for making caustic soda was about 300,000 tons; now it is about 600,000 tons.

### Industries Other than Mining also Overbuilt

When we turn to other industries we find generally the same situation. Among the major manufacturing industries there are one or two, *e.g.*, textile weaving, that appear to be in a good position, but on the other hand there are some, *e.g.*, automobile manufacturing (not to speak of shipbuilding), that are in a very bad way. The great mass of our manufacturing industries fall in between those extremes and in general are in an uncomfortable position as to being overbuilt. We should not, of course, essay to be precise in ratings under this head. Adequate attention to this subject has not heretofore been given and the data that are available are often of only a rough and uncoördinated nature. In mining and metallurgy we know that annual capacity is stated in terms of the 24-hr. day, but in other industries it is given on the basis of an 8-hr. or 10-hr. day and can be increased by over-time work. Next, there is often uncertainty as to what is first-class capacity and what is second-class, or emergency, capacity, and what should be included in an estimation of the total. Every industry is likely to have a considerable portion of its surplus capacity in the form of plant that is old and relatively inferior but not yet obsolete. Finally, there is the question as to how much surplus capacity an industry must have in order to function easily and be prepared to work under peak loads. Even apart from the latter consideration, there are few industrial plants that can be worked at 100 per cent. capacity year in and year out.

After the above matters have been taken into consideration and we have determined the specific capacity

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of our industries, another line of thought pertains to the relation between capacity and the requirement for it. It will be agreed, of course, that the demands made during the war are no criteria. What then? The best guide toward a generalization that I can offer is pre-war consumption, say the average of three years, plus a percentage corresponding with the increase in population, and plus or minus a factor representing increase or decrease in the scale of living. This formula refers obviously only to those industries that are purely domestic. The population of the United States at the middle of 1913 is estimated to have been 97.3 millions. At the middle of 1922 it will probably be about 108 millions, or about 1.11 that of 1913. If, then, we were using 750 million pounds of a commodity in 1911–13, we should expect a use of about 832 million in 1922. We should probably say that the industry should have a 10 per cent. working surplus of capacity, or say an aggregate of 900 million pounds, and that if it had actually capacity for 1800 million it would be 100 per cent. overbuilt.

Lest this illustrative calculation be misinterpreted, let me say that it is my own belief that on the whole American consumption is now below the par of 1911–13 and that when we begin to build up it is going to be from a lower level than 1911–12, meaning, of course, a lower level per head of the population.

### Overexpansion a Consequence of War

Manifestly this is the broadest kind of a generalization and it is not to be applied indiscriminately to individual industries. Thus, no one would think of forecasting the demand for automobiles on the basis of 1913, for that industry has experienced its great growth since that time; vice-versa, as automobile manufacturing has waxed carriage building has waned. There are less spectacular cases of speeding up or lagging behind in individual industries; thus electrification has outrun other industries and we may foresee a continuance of its gain. On the other hand, the provision of railroad transportation facilities has lagged behind the general average.

However, the taking into account of all of these factors and conditions does not ameliorate the general conclusions that our producing industries, with but few exceptions, are greatly over-extended. The magnitude of the over-expansion is a direct consequence of the war. This is not a condition peculiar to the United States. It obtains, I believe, throughout the civilized world. From all that I read the position in Switzerland, Scandinavia, Spain, Holland and Japan is similar to our own. The countries that thought that the war was enriching them at the cost of others buried their new fortunes in factories, ships and other things that are now of no use to them. So with ourselves. We put billions into plant that in plain truth we must throw away and write off.

Yet, we can deduce from this a plain object-lesson. The demands of the war produced conditions in an exaggerated, even a grotesquely exaggerated, way that are developing all the time and induce what are called cycles in business. Broadly speaking, these result from miscalculations. It is found, let us say, that the supply of goods has not kept pace with the steadily growing demand. A rising market ensues. Haste is made to provide new plant with which to meet the demand. Again there is miscalculation. The demand is overestimated. Then there is collapse and depression. Much of the superfluous plant is allowed to rust and decay. While eyes have been blind and minds have been dull the time comes when there is shortage of supply again. Then the upward swing begins and history repeats itself. This is so trite that it is primer economics. Yet we dully abide by the principles of *laisser faire* in this, although we have repudiated that in other things. The consequence of *laisser faire* in this is that we are repeatedly building superfluous plant and eventually throwing it away. This causes an industry to be both over-capitalized and over-manned. On the down-grade the component parts of the industry struggle in a contest for the survival of the fittest. With substantially unchanged overhead expense, itself swelled by the boom, individual plants are operated at only partial capacity; and the enlarged personnel that has become attached to the industry is able to work for only part of the time. If the competitors are pretty evenly matched this condition may become chronic, as has been the case for many years in the bituminous-coal industry.

We can now see just these events crystallizing in a new industry, *viz.*, automobile manufacturing. There are more than 100 manufacturers, with annual capacity for producing 2¾ million cars, and they are still adding to capacity. Walk through any city and note the sales rooms, each with its own corps. I need not dwell upon what overhead means in this industry. There were made during the last year two careful, outside studies of the absorbing power of the domestic market for automobiles. One forecast was for 1½ million per annum; the other for about one million. What is likely to happen in this industry is pretty clear.

I need not elaborate upon the economic inefficiency, or waste, if it pleases any one so to call it, that results from overbuilding. Nor shall I seek to obscure the responsibility for it by attributing it merely to human nature. If we accept the generic division of the forces of production into capital and labor, the former is in the main the responsible party, for it leads while labor follows, blindly and helplessly. Yet labor is not free from blame inasmuch as there are important cases wherein industrial overbuilding is clearly attributable to the policies and actions of labor unionism. Thus, the manufacture of boots and shoes was driven from its primary centers in Massachusetts into the country regions of New England and then to places as far west

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as St. Louis. At this moment shoes made in St. Louis are sold in Lynn under the very noses of the local manufacturers. Similarly was the book printing industry driven extensively from the large cities to suburban and country towns. Clothing manufacture which was centralizing in large factories in New York has been dispersed among a myriad of small shops. Such developments, under labor union pressure, spelled for these industries over-building, over-staffing, and over-manning, with the consequential evils of increased costs and short-time work.

In the exploitation of natural resources we are subject to the same broad economic laws that govern other industries, but we have the modifying, or disturbing, factor of treasure-trove. However, this does not introduce conditions very different from those obtaining in manufacturing, for the manufacturing industry may find a treasure in a new invention. The essential differences between the exploitation of natural resources and the utilization of them is that the primary exploiters are subject to the vicissitudes of exhaustion and the stress of competition may lead them to skim the cream and let the rest go to waste, while the effect of excessive competition in manufacturing is just the opposite, *i.e.*, it is inspirational toward the avoidance of waste. As mining and lumbering concentrate in the hands of great companies, the raw materials becoming the foundation of an integrated business, they tend to be operated according to manufacturing principles rather than on those of the adventurer.

### Soundness of Metal-mining Industry

I think that on the whole we kept our metal mining industry upon a fairly sound basis up to the advent of the war, since when it has been the victim of unfortunate circumstances, rather than its own folly. Although of immense importance, it is conducted by a small personnel, only about 150,000 men being engaged, which is the result of the mechanicalization that our engineers have accomplished. In general, the personnel obtains full-time employment. There is overdevelopment, to be sure, but the adverse consequences of this, as well as those of ups and downs in the market, fall more upon the stockholders than they do upon the workers. I have in mind especially the copper, lead and iron industries. The situation in zinc has never been so good as in the other branches. Following the war, however, we have had new and unfavorable conditions in all of the branches of metal mining, and how we are going to conform to them we do not yet know.

We must not, however, seek to excuse ourselves, but rather should we consider that our industry plays a part in the entire economic fabric of the country and that as a whole we are not attaining the efficiency that is possible. The fundamentals are to be looked for, not in our methods of doing our work, although that is a subject of great importance, but rather in the economic conditions that attach to an industry more workers than is needful and in those that produce severe undulations in the scale of employment even among those industries that are not overmanned. The underlying cause may be summed up in the single word "miscalculations." If I were less practical and more theoretical I might find myself arguing toward state socialism, which I abhor in common with all other varieties of socialism, but my philosophy, together with my observation of experiences, teaches me that that is wholly wrong. Miscalculations are manifestly due to ignorance. Where then are we to seek the remedy? Not among politicians, for we have learned too well that in industry the hand of the government is the touch of death. Not in labor, for labor does not know enough, and the most we ask of it is not to be an impediment. Not among capitalists, purely speaking, for they are inert and about as helpless as labor. There remains only management, whereof we engineers constitute a part. It is management that must shoulder the whole responsibility. There is no use in debating any assessments of blame between management and labor. Let us forget the word blame and assume the whole of the responsibility. This will be looking forward, not backward.

What, then, does this mean and imply? The answer is simply what is expressed in this formula:

*Miscalculations in industry will decrease along with increase in the transparency in industry, which tends toward the establishment of equilibrium.*

Transparency in industry means merely the acquisition of knowledge about it and thereby the ability to see through it and ahead. The basic cause of booms, with all their evils of price inflation, over-expansion, waste and inefficiency is that we fail to look ahead. In times of depression we should prepare for the future, and by doing so we can cure the depression itself. It is largely absence of knowledge of conditions, and the obscuration of our vision, that prevents us from doing this. It is vitally necessary to the industries of the country to have illuminating statistics of production and consumption, producing capacity, and all other factors, and to have such statistics promptly available. The position of the business man who does not have all the needful facts is like that of the automobilist who undertakes to drive without headlights.

The formula that I have offered does not hold out any promise for an early, complete solution of economic troubles. I think it will be about the millenium when that result is achieved. But we can progress. Indeed we are doing that now. Yet it is going to be a long time before much can be accomplished, simply for the reason that our existing knowledge is so scanty and imperfect. In adding to knowledge we, as engineers, are playing our part. The introduction of this subject into our discussions is an inspiration to us to speed up. Just as in the war, when we learned how to coöperate better, there is still a call for everybody to do his bit. Let illumination and clear-thinking be our mottoes.

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# The Engineer and the Federated

AT THE dinner at the Cosmos Club in Washington, tendered to Herbert Hoover on Jan. 5, on the occasion of his retirement from the presidency of the Federated American Engineering Societies, he made an informal speech in which he pointed out not only the unique position which the engineer now occupies by virtue of the new Federated Societies but also the opportunity that is thus presented for national service. In this connection and in pointing out some of the reasons for the present economic maladjustment, Mr. Hoover said in part:

This body has entered upon a path of public service that is unique in the whole United States.

The engineer has devoted himself all these years to the upbuilding of the material values of the United States. He has done that effectively—more effectively than has been accomplished in any other of the great countries of the world.

The birth of this society marks the evolution of the engineer into an interest in public affairs. With his intelligence, his experience and training and the unique knowledge that he possesses not only of the material but the intangible values among our people, he is now organized so that his united voice may become heard outside of his profession.

We have probably 175,000 engineers in our country, representing an intellectual possibility for service possessed by no other group. It is therefore an augury of real social development when the engineers of the United States join together for purposes of public service.

This association has the unique value among the associations that it can not have any material interest for its purpose. No engineer can receive any material benefit from it. It can advance no economic interest. It can not therefore be charged with any ulterior motive.

We resolved early in the progress of the Council to undertake an investigation into the elimination of waste—a problem with which the engineer alone was fitted to deal, a problem that had not come in for solution outside of engineering circles. As a result of the investigation carried on during the past year and of the report made, there has been an enormous expansion of the consideration of these fundamental questions—questions that enter into the whole problem of the standard of living of our people.

We have enlarged our vision as to what constitutes waste. We are suffering today from one of the most fearful wastes that can come to us in that we have from two to three millions of idle men.

There are many ramifications of the waste problem which you are familiar with, many, more familiar than I am, but there is one factor in the saving of waste that I believe the engineers might give further consideration to and perhaps more investigation; and that is the problem of a larger view in electrification.

We are all aware of the results obtained in the investigation of the superpower development of the Atlantic seaboard. Superpower is not impossible in many other sections of the country. We are indeed on the threshold of enlarging the distances of transmission. We have the possibility of reducing waste through a large phase of electrical development made during the past thirty years. The American people have no appreciation of the possible results and the added efficiency, productivity, safety and advance that could be obtained in the enlargement of our entire electrical equipment. And there is no body that could give this problem such consideration and so illuminate it in the national sense as this Council could do. Indeed, it requires the services of every branch of engineers that compose the Council. With the possibility ahead of us of the development of some twelve to fifteen millions of horsepower, the consolidation of hundreds, even thousands of minor plants, the enormous savings to be made through the substitution of electrical power for steam—there is a probability of the greatest material saving of waste possible in any country in front of the American people.

It is one thing to suggest a problem and another thing to suggest its solution. It is a far more difficult thing to state a problem in a fashion that people will understand and state its solution in a fashion that will carry conviction. An association of this kind has the opportunity to develop popular conception of its ideas more effectively than any other group in the country.

There is no state or city or municipal government that does not need the advice of the Engineering Council. There is no problem either in federal or state or municipal legislation that does not at some point touch upon material construction and therefore come within the purview of the engineer; so that while the Council, in Washington and in those centers where the directors can keep in contact with needs and the problems in hand, does great service, the same opportunity and the same need exist throughout the country.

I know of no way of inspiring service except by contact. That service, the country needs. It needs the plans and the intelligence of its engineers—the men who have, in the very nature of their work, the inspiration and enthusiasm and yet are great realists in the work—and they are the men who should be heard from.

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# Elimination of Waste in the Coal Industry*

BY EDWIN LUDLOW

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IN CONSIDERING the waste in the coal industry, which is the title of this discussion, we must entirely eliminate the anthracite region. The demand for anthracite has been constantly increasing and the mines have been able to run during this last year, while the bituminous field was idle for two-thirds of the time. It is on a 100 per cent. basis, which is the best answer to any waste in industry investigations. The anthracite region is also in a very much better position on account of its control by very large companies which realize that their resources are limited; they must husband these resources in every way and they are making the most careful study of methods of mining and preparation to avoid any possibility of waste. This is well known and realized by the managers of those companies. Even the fine slush which was formerly thrown away is now being stored in the hope that methods will be found by which it can be used economically, either in briquet or pulverized fuel in coking. This has been tried.

The anthracite factor may be dismissed from the waste in industry discussion, except as it applies to the general public that burns anthracite; there is a tremendous waste of anthracite in the burning of it. Looking at the ash piles where anthracite is burned and seeing the amount of carbon that comes away with the ashes, one realizes that proper efficiency is not obtained in the burning of that coal. Even its higher cost does not seem to bring people to a realization of the necessity of conserving and burning properly the entire coal carbon content of what has cost so large a price. Many people feel that they want to have the coal as large as they can shovel into the furnace; they do not realize that the small coal makes just as many heat units and can be bought at half the price. Consequently, the demand is continually in excess of the probable production for the larger sizes of anthracite, while the smaller sizes, such as large buckwheat and pea, are a drug on the market and can be bought at nearly half the figure; and yet, if properly burned, these produce just as much heat and can be used with a much greater economy than the large egg and stove.

In the bituminous field there is a tremendous waste. The production this year was only 410,000,000 tons, against 550,000,000 last year, and with a potential capacity of 800,000,000 tons. There is a tremendous wastage of development and wastage in the competition that goes on; and there is very little excuse for it. Fortunately, most of the coal operators in the bituminous field are optimists. If they were not, they would never go on or stay in. Almost every summer they are idle a large portion of the time, but when winter comes around they have orders in excess of their production, on account of short car supply. They go on, therefore, into the next spring and develop, hoping that next winter the car supply will be better. It is that optimism that keeps on developing the soft coal field. There is another feature that comes in and that is the belief that a great many companies have that they can go into a virgin field and produce coal cheaper than from old mines which have been running for a good many years and must therefore have pretty heavy maintenance charges. That causes a waste in mining and competitive prices.

## Three Classes of Soft-coal Mines

The soft coal mines should be divided into three classes, according to the methods of mining: First, those that are under the control of large leasing companies that have bought up the land, have leased the properties on royalty and have an efficient corps of engineers not only to watch the operations but to draw up the leases; second, the mines that are owned by large companies and must conserve their resources and obtain as much coal as is possible from their properties —they also are large enough to employ an efficient corps of engineers; third, a class that is to a large extent composed of purveyors of coal or leasers of blocks of land from different owners. They make these leases with the owners, who are not coal men and who have no engineers employed, through lawyers who know nothing about methods of mining or how proper protection is afforded to their clients; and in consequence they are enabled to go into these properties and gouge out the cheapest coal when the market requires. It is cheaper

* Address at joint meeting of Mining and Metallurgical Society of America and American Institute of Mining and Metallurgical Engineers, Feb. 22, 1922.

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for them to leave a foot and a half of top-coal to hold up the roof than to put in timbers. Mines of that kind are scattered through Illinois.

The subject of waste in coal mining, and what can be done by better methods of mining, was probably better brought out by the paper of Mr. Clagett,[1] who represents the landowners who lease a large part of the coal in the Pocahontas field, than anything yet given before the Institute. He gave the percentages of extraction through periods of years and showed the beginning of a little over 1000 tons a foot-acre brought to an extraction of 1400 tons a foot-acre, and also showed that the percentage of recovery is coming up now very close to the 90 per cent. line, which is about as close as we can work with any method except possibly the longwall, which was not applicable to that field.

The waste in industry in the amount of coal that is being left in the mines and there abandoned is really becoming an important feature in the economic life of our country. Formerly we lived on the theory that we have "coal to burn," but now we are beginning to realize that the best of our coal is becoming a little scarcer and that greater care should be exercised. The engineers are the ones to take up this matter, and the papers that we have had read before the Institute on existing conditions of mining are very illuminating. The publication of those papers and the diagrams of the methods by which the largest extraction was obtained should be of the greatest value to mining men all over the country.

### Model Lease Needed

There is one thing more that should be done for the protection of the coal industry, and that is that men like Mr. Clagett, who have been making leases, should draw up a model form of a lease that would be so advertised that the lawyers who draw up these leases for their clients would know about it and would use it for the protection of their own clients.

The developments that have been going on and the large excess of capital invested in coal mines is due to the very cycles of excessive demand for coal such as we had in 1920, when, owing to the switchmen's outlaw strike, there was a shortage of transportation which prevented coal from getting to the consumer. The market got excited and became a buyers' market, where men rushed in and bought at any price; others who heard of coal lands rushed out and leased them and the consequence was the development of 200 new mines in that year which had no market for coal as soon as things were restored and transportation became normal.

The method of handling was hardly determined. It was a question of transportation, not of industry. The outlaw strike shortened the car supply so that the coal could not be moved on contract, which had a most demoralizing effect. It produced an excessive amount of coal development and this has had a most clogging effect on the market in every part of the country.

The great trouble with the coal business, also, is the short-term contracts. Every man who loses a contract this year knows that that contract runs only for a year and he keeps up his organization and sharpens his knife in order to take a whack at the same contract next year and get it back. If contracts could be arranged on a longer-term basis, it would give much more stability to the coal operations. Investors in coal would feel that they could go ahead with development under the security of a certain market at all times of the year. Prices, of course, would fluctuate, but they would then have something to go on; there would not be the same ambition to develop any little piece of coal available. It would have a strong, stimulating effect, and it would have what the industry must have—a survival of the fittest. We have more mines than we need in this country; we must get along with fewer mines and keep them running more steadily. It is the only solution of that particular waste in industry. It will save a waste in labor, in capital and it will economize in every way and save a great deal of the waste in mining; mines cannot be kept in proper condition when they are running only 30 per cent. of the time.

There is another waste in mining in the bituminous field, in which I hope the public will help; that is in the burning. Some reports made on that subject showed that the best public utility in Massachusetts reduced its coal consumption 20 per cent. on the average. If a large public utility purchasing 500,000 tons a year could make a 20 per cent. saving, a great deal of money might be invested in better boiler practice. The boiler practice all over this country is extremely bad. It is being developed gradually by large public utilities and their results are continually improving; but if we could only get the burning of the coal even to the average of the public utility, it would represent a tremendous saving in the amount of coal consumed each year—a saving that would be a saving in wealth to the country, because we cannot continue to exhaust our coal resources at the rate we are now doing and expect to keep it up forever.

This matter is a question that the engineers need to take hold of. This investigation should be made by mining men, by coal men, and the only way to obtain results from it is to show what should be done, both in mining and in burning coal, so that a man can see for himself whether his own plant is up to the standard or not.

The whole subject must be one of continuous study. It must be studied, though, by men trained in the business, and it should be taken up by a committee of the Institute and not be left in the hands of men who are not in the coal business; efficiency engineers may be very good in their own way, but they do not know much about underground work.

[1]Systems of Mining in Pocahontas Field, presented at morning session on Wednesday, Feb. 22.

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# Engineer's Relation to Elimination of Waste in Mining*

By J. PARKE CHANNING

Consulting Engineer, New York City

ALTHOUGH the original thought of investigating waste in industry came from a mining engineer, Herbert Hoover, and although the chairman of that committee was a mining engineer (although the real work was done by the vice-chairman, L. W. Wallace), it is an interesting commentary that when the report first saw light, at St. Louis, on the first of June, 1921, some people most violently went up in the air when it was submitted by the representatives of the mining engineers.

At the time they resented most markedly the report of the committee that 50 per cent. of the waste in industry, or as Mr. Ingalls in his paper has properly said, inefficiency in industry, was to be laid upon management. The reason for that seems to have been that, as a whole, the mining industry is pretty well organized and is superior to a large number of manufacturing industries including those studied by the Report.

However, this very meeting shows that even the mining engineers have finally realized that there is waste or inefficiency in mining and that a large proportion of it can, with propriety, be assessed against management.

## Ideas Have Been Clarified

After long sessions in determining a name for this Committee, it finally was decided to use the words, "waste in industry." We realized that the word "waste" was probably not the best word, but we realized that it was a striking word and that it was one which would call attention. "Efficiency," and "inefficiency" have been worked to death; the word "waste" had not been used. Of course, the trouble is that a great many people have imagined, with propriety, that when we used the word "waste" it meant waste of material. What we really wanted to bring out was waste from the human side; waste of human effort, both physical and mental.

The Committee has done good work in clarifying our ideas upon this subject. I think that probably one of the very best things was the division of waste and of those four causes of waste, to which Mr. Yeatman called your attention—that is, low production, interrupted production, restricted production and loss of production. Having those four major divisions before us, we know how to properly classify various kinds of waste, and when we know the real causes of things, we know very much better how to take them up and how to correct them.

## Establish Standards of Production

One of the important things, to my mind, in the elimination of waste of low production, in mining, which is mentioned so often in the various industries investigated, is what are called standards of production.

They say, for example, that one of the great deficiencies in the garment trade was want of standard of production; whereas in the metal industry there are certain standards of production.

It seems to me that possibly we could, with great propriety, establish standards of production. It is found that when we get proper standards of production and have them thoroughly understood, we can get along in an industry or in a factory and get good results, whether the men are paid by the day or whether they are paid on contract. It may be possible that in a particular mine this cannot be applied. I think it is possible that we may say, "standard of production for a drift; standard of production for a raise; standard of production for a stope." In other words, so many feet of drill, so many feet of advance, as a proper and a fair day's work; if a man accomplishes that—if on day's pay—he is to be continued; if he does not come up to that, the only thing is to get rid of him. If you are working on a contract basis you know your standard of production, and the man is paid according to his efficiency or what he produces; so that I think that one thing, the standard of production, is the thing that we should look into.

Mr. Yeatman's paper is such a classic that it has covered almost everything which by any possibility I could say upon the subject. The author has touched upon all the points which in my experience I have run across—the troubles that come from the president, the directors, the manager, the staff and the workmen.

* Address at joint meeting of Mining and Metallurgical Society of America and American Institute of Mining and Metallurgical Engineers, Feb. 22, 1922.

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He has also stressed the one particular thing which I think is most important in the character of attainment of a mine manager and that is, first and primarily, he must be an engineer. He must be a man with technical training, which, perhaps, he may not have acquired in a college, but may have acquired by burning the midnight oil. He must have engineering knowledge so that when his subordinates talk to him, he can answer them in their own language.

It is impossible, to my mind, for a man to come up and be a successful mining engineer through the office, through the business department, through the traffic department. He may come up through the engineering forces, he may come through the assay office, be he not a college graduate, but unless he does have scientific training, scientific point of view, he cannot be a successful mine manager. He must, of course, have business ability. The best scientific mind in the world, without business knowledge, will not make a successful manager. He must, in addition, have knowledge of what we now call human engineering. He must have knowledge of men. He must know how to handle them. He must have the feeling that inspires confidence, not only in the members of his staff, but in the most subordinate man.

Milton H. Smith, a railroad president in the South who died a few years ago, was president of the Louisville & Nashville, and his great success was his great knowledge of men and his love of men. They say that there was not a section foreman that did not know old Milton H. Smith and would do everything in the world for him. First you want scientific spirit and knowledge, business ability and finally knowledge of human nature.

I have just finished reading a most interesting book by Sir Ian Hamilton on the Body and Soul of an Army, and all through that ran his suggestions which in nearly every case apply to the operation and organization of a mine and its reduction and smelting work. One of the things that impressed me more than anything else was that a man in the very highest executive position should not have under him too many men—brain workers like himself, who reported to him and who came to him with the final decision.

His opinion was that no leader of men should have under him a staff of more than six—that when a man attempted to guide more than six men, he either fell down or he killed himself by overwork. He even went so far as to say that he thought that in the very highest position, with the largest responsibilities, possibly three were enough; that as you went down the scale you could have more and more; that a superintendent might have ten men under him, whose minds he had to direct and of course when you got down to a foreman, sub-foreman, the number could be increased.

In my early experience on Lake Superior, the manager of the mine was a Cornishman who had brought himself up to a high standard and who ran his mine always on day labor; his rule was that he had a boss for every ten men and in all my experience I never saw a more efficient or better operated mine.

Mr. Ingalls has also brought out a great deal that is fundamental. We must realize that in mining, as in a great many other industries, a great deal of the fault of waste (I do not say blame—we were particular in our report to eliminate blame) is due to the people still higher up than the managers—and those are the financiers. The financiers, without the proper knowledge of economics, are the people who have caused us either willingly or unwillingly to overequip our industries, not only mining but others. Those are the people who have to be educated and I think the function of the engineer is, as Mr. Ingalls has brought out, to educate the capitalists and to educate the workmen.

I believe that the higher leaders in labor-union circles are students of economics. The newly-created Bureau of Economic Research has on its board members of the labor unions. The recently organized Personnel Research Federation has on it members of the American Federation of Labor. Those men are not socialists; they are not communists; they are not anarchists, not Bolshevists; they are every one of them strong supporters of the capitalistic system of production and they realize just as well as we do that what we want is light and that clarity in industry which for so long we have not had.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Taylor Society | Philadelphia, Pa. | Mch. 16–18 |
| Amer. Chem. Soc. | Birmingham, Ala. | April |
| Amer. Welding Soc. | New York, N. Y. | April 27 |
| Amer. Electrochem. Soc. | Baltimore, Md. | Apr. 27–29 |
| Public Conference on Commercial Engineering | Pittsburgh, Pa. | May 1–2 |
| Iron & Steel Inst. | London, England | May 4–5 |
| Amer. Zinc Inst. | St. Louis, Mo. | May 8–9 |
| Amer. Soc. Mech. Engrs. | Atlanta, Ga. | May 8–11 |
| Foreign Trade Convention | Philadelphia, Pa. | May 10–12 |
| Amer. Foundrymen's Assn. | Rochester, N. Y. | June 5–9 |
| Inst. of Metals Div. A. I. M. E. | Rochester, N. Y. | June 5–9 |
| Amer. Assn. for Adv. of Sci. | Salt Lake City, Utah | June 22–24 |
| Amer. Soc. for Test. Mats. | Atlantic City, N. J. | June 26–July 1 |

**Experiments on Possible Production from Oil Wells after First Abandonment.**—According to the Chief Petroleum Technologist, the failure to effect greater recovery is due to the exhaustion of the subterranean gas flow. By experimental processes he has shown that it is possible to recover from 15 to 25 per cent. more oil, depending on the pressure used.

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# Present-day Iron Blast-furnace Practice

By RALPH H. SWEETSER

Assistant to Vice-president, American Rolling Mill Co., Columbus, Ohio.

THE present state of iron blast-furnace practice is metallurgical rather than mechanical; the tendency is toward intensity rather than toward extension. The engineers have built blast furnaces big enough and strong enough, and have furnished accessory equipment ample and accurate enough for the present state of the art, but the metallurgical side has been too much neglected; the metallurgist, rather than the engineer, is now the man on whom the present and future progress in iron blast-furnace practice depends. The mining engineer has produced great tonnages of iron ores, and has kept ahead of the demands for quantity; now the metallurgist is improving the chemical and physical qualities of this product by ore-dressing and other forms of beneficiation. For a generation or more, the principles of mechanics have had most influence in the advancement of iron blast-furnace practice; attention now is given more to the principles of metallurgy, chemistry, and ore-dressing.

This metallurgical progress is taking place inside and outside the blast furnace. The two great determining factors of the inside operation are the slag, and the rate of combustibility of the coke. Outside the furnace, the progress is, and will be, along the lines of more careful mixing of ores and iron-bearing materials, in the sizing and washing of limestone, and in the character and structure of byproduct coke.

## Blast-furnace Slags

There have been almost as many theories on blast-furnace slags as there have been blast-furnace superintendents; and many of the theories were wrong, including my own.

During the war several important articles on blast-furnace slag were published, perhaps the most notable paper being the one by Alexander L. Feild and P. H. Royster.[1] This article did not at the time receive the attention and discussion it deserved. Blast-furnace men for the most part were concerned in keeping their plants in operation so as to produce the greatest possible tonnage, and there was practically no time for technical discussion. The paper, however, was of the utmost importance and brought out some facts contrary to the general opinion of blast-furnace superintendents. These facts are now receiving more attention and the information developed, and since proved, is being used in burdening the furnaces. Mr. Feild and those discussing his paper pointed to the fact that the information obtained by the use of pyrometers in determining the melting points of slag had helped to remove "another element of uncertainty from the problems encountered in practice." On the other hand, this same paper had some imaginings that did not sound at all practical, though it might be hard to disprove them.

Investigations are being carried on to determine the value of certain slags with special reference to the effect on the blast pressure and the general working of the furnace. The development of the investigations of the Bureau of Mines and of individual blast-furnace men have upset many of the preconceived notions regarding the causes of blast pressure inside the furnace. Further investigations are necessary to demonstrate fully the relation between the composition of the blast-furnace slag and " the sticking and slipping" of furnaces.

## Slag Disposal

The demand for crushed slag as an aggregate in concrete work has increased in recent years, and much blast-furnace slag now goes to the crushing and screening plants. Dry pits and steam shovels are generally used. Where granulating pits are still in use, it is usual to throw the wet slag into piles in freezing weather so as to drain off as much water as possible before loading it into railroad cars.

## Fluxes

More attention is now being given to the question of blast-furnace fluxes than was formerly considered necessary. As a rule, the limestone for blast-furnace flux was chosen on the basis of cost and freight rather than quality, providing the carbonates of lime and magnesium made up about 95 per cent. of the stone. Open-hearth slag is being more commonly used, especially where the blast furnace is a part of the steel plant. This is an economical way to dispose of the slag from the open hearth, and it is a double source of metal and flux for the blast furnace. In some cases the amount used is 10 per cent. of the total ore burden.

Magnesia is still a subject of controversy, but Mr. Feild's statement[2] that "Magnesia (MgO), as such, does not affect the slag viscosity so far as practical

[1] Slag Viscosity Tables for Blast-furnace Work. Abstract in *Trans.* (1918) **58**, 650. Complete paper published by Bureau of Mines as *Tech. Paper* 187.

[2] *Op. cit.*

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purposes are concerned unless present in amounts greater than 8 per cent.," is being more generally believed.

The size of the flux stone still varies greatly in the different iron-making districts, and in many cases the run of the quarry crusher is accepted providing the fine dust is screened out. It is generally conceded that a closer sizing of the flux stone is beneficial; and where "ballast size" stone has been used there has been some improvement in the working of the furnace. At a few large quarries the stone is washed after crushing.

### Coke

"Poor coke" has been the excuse of many a blast-furnace superintendent for the poor work of his furnace, and no doubt the poor coke deserved much of the blame; but, what is poor coke? The Coke Comittee (Committee D–6) of the American Society for Testing Materials is even sending out questionnaires asking "What is coke?" Some of the poorest looking coke, judging by the old standards of luster, "long fingers," and "metallic ring," now gives the best results in the blast furnace.

Exact specifications for a good blast-furnace coke have not yet been generally accepted, but efforts are being made to find standard tests for determining the value of byproduct cokes. The rate of combustibility has been brought forward by Herman Brassert and others as one of the determining factors of the value of a coke. Resistance to breakage is another quality that is desirable, for which a proper comparative test is being sought. Much valuable work in this direction is being carried on by J. C. Barrett, at the Ohio works, in his tumbling-barrel tests.

It is claimed that if the blast-furnace men can specify a certain rate of combustibility, and a certain toughness of structure, it will be possible for the byproduct coke-oven man to produce the desired coke by carefully mixing the coals for the ovens.

There is need for much research work to determine the proper structure and size of cokes, and to find the right descriptive terms for the relative values of the different cokes.

### Standardization

The indictment brought against "the management" in general, in reference to the responsibility for the excessive waste in industry, has been well deserved by the management of most blast furnaces. Until recently there was not even an approximate rule for determining the tonnage that should be produced by a blast furnace of a given size. In many cases the coke per ton of pig iron at one furnace was compared with the coke per ton of iron at other furnaces without any reference to the quality of the cokes used or to their contents of fixed carbon.

The rule for rating the capacities of blast furnaces adopted by the Southern Ohio Pig Iron and Coke Assn. (published in the trade journals) is based on the burning of a certain amount of a "base" coke in a given time (60 lb. coke per cu. ft. of working volume in 24 hr.). Starting with the idea that there is a definite rate of combustibility for a standard coke, assuming that the ore mixture contains 51.50 per cent. iron in the natural state, and arbitrarily using 1800 lb. of coke per ton of basic pig iron when the fixed carbon in the coke is 90 per cent., it is a simple process to determine what any blast furnace should make under varying conditions of coke, ore mixture, and percentage of silicon in the pig iron.

The general acceptance of a standard coke is the next step in the advancement of blast-furnace practice. The United States Bureau of Mines, the American Society for Testing Materials, and other associations are trying to solve this problem.

In the operation of blast furnaces, especially at plants that began when all the pig iron was handled by man power and all the raw material was hauled in buggies, there has been too great a delay in getting rid of old customs and wasteful practices. Many of us can remember when blast furnaces 85 ft. high would have cover plates over the whole length of the casting trough at casting time. Even after the adoption of tap-hole guns, and electric drills for the iron notch, and casting machines in place of pig beds, there was a tendency to retain men in the cast house in greater numbers than needed. This was because there was no accepted standard for a day's work around the blast furnace. The adoption of these standards may seem to work hardships, especially in times of unemployment, but it is the only course to take if management is to get rid of the stigma of wasteful practices.

### Beneficiation of Ores

The physical qualities of iron ores are being improved by all the old methods of washing and roasting brought up to date, such as sizing (and crushing where necessary), washing, drying, nodulizing, sintering, and magnetic concentration. The sintering process has found extensive use in changing flue dust into a desirable blast-furnace raw material; it is also successfully used in preparing fine magnetic concentrates for blast furnace use; in some instances the sintering process is used instead of roasting for the removal of sulfur.

### Cost Accounting

Great progress in blast-furnace practice was made by the adoption of the Croxton Efficiency System with its uniform method of cost accounting. However, this method allowed only a comparison between one month's cost and another, or else only between the cost at one furnace and the cost at another. The only true comparison is between the actual cost for a given month and the standard cost for that month at that particular furnace. Such a comparative cost system has already been put into use.

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The pig-iron cost sheet at most blast-furnace plants has been used almost exclusively as a guide for the sales department, and it has seldom been used in its other and more important function, as a guide for the successful operation of the blast furnace itself. Such a cost sheet, in order to be of full value to the furnace superintendent, must be promptly available and approximately accurate. When the actual amounts of ore, coke, limestone, labor and supplies, and the actual costs per ton of pig iron for these items, are compared with the ideal costs for that month, using standard amounts of materials and labor at the actual prices and wages, then, and then only, is a comparison made that is fair to the management, to the superintendent, and to the furnace.

In spite of the increased cost for freight in assembling raw materials for making pig, the location for new furnaces seems to be governed more by the market for the ron than by the location of any of the raw materials.

## "Synthetic Gold"

PROFESSOR Irving Fisher, of Yale University, is the present-day leading exponent of the quantitative theory of money. According to this theory the prices for commodities are a direct function of the quantity of gold existing and available as a medium of exchange. Professor Fisher has proposed to abolish the fluctuations that he attributes to this cause by a plan for "stabilizing the dollar," which dispenses with gold. There is, of course, no doubt that the influx of a new, adventitious supply of gold would have a profound effect upon prices, just as did the bringing of the treasures of Mexico and South America to Europe by the Spaniards in the 16th century, but the quantitative theory, which has been controversial for 300 years or more, has never been universally accepted, and the economic events of the Great War did more to discredit it than anything else.

However, Professor Fisher is unshaken and he is ever in a state of mind for seeing bogies. Recently at the London School of Economics and Political Science he declared, "on credible authority," that a German chemist had discovered how to make synthetic gold, and suggested that these wicked (and scientific) Germans are going to make the reparations scheme ridiculous by paying off in a metal that will henceforth have only a nominal value. Lest gold miners, who may have seen this declaration widely published through the press, become scared, we give some words of comfort, which we can do no better than in the language of the Scientific Correspondent of the London *Times*, as follows:

> It is dangerous to deny the possibility of any achievement of science, but I do not know of any existing knowledge which suggests that a chemist can yet transmute the baser metals into gold. The transmutation of elements has indeed been accomplished, and theory now points to all the elements being built up of common materials. The radioactive elements disintegrate very slowly but the disintegration is spontaneous, not a result of laboratory methods.
>
> The energy locking the structure of these heavy elements is prodigious and requires prodigious forces to unlock it. Possibly a process will be found, or may have been found, by which the application of radioactive substances to mercury or lead breaks these down, leaving gold as the residue. The stock case of transmutation of an element is that of nitrogen. Rutherford, by bombarding it with alpha particles, succeeded in breaking it up into hydrogen and helium. But even if it were possible, the purchase of radium to transmute lead or mercury into gold would not be an economical process.
>
> It is to be noted that all the cases of transmutation, spontaneous or induced, known as yet are examples of analysis, the breaking up of a more complex element into simpler elements. The triumphs of synthetic chemistry, where simpler substances are combined to produce more complex substances, relate to molecules, not atoms. The forces by which atoms combine in molecules are not only almost infinitely smaller than those which cause the adherence of protons and electrons into the atoms of elements, but are well within the range of experimental handling.
>
> The contrast between molecular and sub-atomic energy may be realized by recalling a famous dictum of Sir Oliver Lodge. He calculated that the energy within the atoms of the piece of chalk which he was using to make a diagram on the blackboard amounted to 300,000,000 foot tons. I do not know if the molecular energy in the same piece of chalk has ever been calculated, but at the most it is in the order of inch-ounces. Could the sub-atomic energy be harnessed it would raise 100,000 tons to a height of 3000 ft.—possibly more than enough to build the pyramid of Cheops. The molecular energy can be harnessed, and I doubt if it is more than that used in laying a trowelful of cement between two of the blocks.

We may amplify this with a few sentences from a lecture at the annual meeting of the National Academy of Sciences in Washington in 1914, by Prof. Sir Ernest Rutherford, the great authority on the constitution of matter and the evolution of the elements. The transformation of matter has indeed been definitely proved. For example, starting with uranium there is derived ionium, then radium, next polonium and finally lead. The primary element of this series is half transformed in 5,000,000,000 years, it is calculated. Half of the ionium changes to radium in 200,000 years. Radium becomes polonium in 2000 and some odd years, while polonium, the sprinter, becomes lead in 136 days. Thorium is known to be a primary element whose radioactive life is even longer than that of uranium.

The processes occurring in radioactive matter are spontaneous and uncontrollable. There is at present no evidence that we shall be able in any way to influence them. This would only be possible on a large scale by altering the rate of radioactive change and causing an element like uranium or thorium to give out its energy in a few hours or days instead of during some billions of years. Radium emanation changes half to radium A in 3.85 days and in that period one pound of the gas emits energy equivalent to that of an engine working at 128,000 hp. per day. This affords some indication of the intensity of the forces required to build up lighter into heavier atoms. Professor Fisher and the gold miners of the world may rest assured that German schemers are not going to play any trick in the matter of reparations by flooding the world with "synthetic" gold.

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# A Code of Ethics for Engineers

THE Joint Committee appointed to consider a Code of Ethics for Engineers recommends, after deliberate consideration, that each participating Institute or Society adopt the short simple Code of Ethics following this report.

The Committee further recommends that the following method of interpreting and administering the Code be adopted by each participating Institute or Society after any necessary provisions have been made in the Constitution and By-laws of the Organization.

The President of each Society or Institute shall appoint a *Standing Committee on Professional Conduct*, to administer the Code of Ethics. The duties of such a Committee shall be to interpret the Code and to render opinions on any cases of questionable conduct on the part of members that may be submitted to the Committee. These interpretations shall be reported to the Executive Board of the Institute or Society who may approve these interpretations, or take such other action as may seem just and necessary. The reports of the Committee on Professional Conduct, when approved by the Executive Board, shall be printed in abstract *and in anonymous form* in the Institute's or Society's monthly journal for the instruction and guidance of fellow members.

This Committee on Professional Conduct shall be appointed in each Institute or Society by the President holding office at the time of the adoption of this Code and shall consist of five members, one appointed for five years, one for four years, a third for three years, a fourth for two years and a fifth member for one year only. Thereafter, the President then holding office shall appoint one member annually to serve for five years, and shall also fill any vacancies that may occur for the unexpired term of the member who has withdrawn. These appointments shall be made from among the older members of the Institute or Society, so that advantage may be taken of their mature experience and judgment. The Committee after appointment shall elect its own chairman and secretary. The Committee shall have power to secure evidence or other information in any particular case not only from the organization's own members, but if it should seem desirable, from men in other professions. The Committee may also appoint sub-committees to consider certain cases when deemed necessary.

This Committee shall investigate all complaints submitted to it *by the Secretary of the Institute or Society* bearing upon the professional conduct of any member and after the member, involved has been given a fair opportunity to be heard, the Committee shall report its findings to the Executive Board of the Institute or Society. This report may in some cases suggest certain procedure of the Executive Board.

The Executive Board of the Institute or Society shall have power to act on the recommendation of the Committee on Professional Conduct, either (1) to censure by letter the conduct of the member who has acted contrary to the Code, if the breach is of a minor character, or (2) to cause the member's name to be stricken from the roll of the Institute or Society.

Copies of all reports made by a Committee on Professional Conduct to the Executive Board of each Institute or Society shall be furnished to each other Committee on Professional Conduct administering the Code. This will keep each Committee advised of the interpretations of other Committees, and in time an extended interpretation of the Code can be written based on the reports of the various Committees on Professional Conduct.

As interpretations of the various Committees on Professional Conduct administering this Code may vary at times, it is recommended that the Chairmen of these Committees of the various Institutes or Societies be authorized to act as a Joint Committee to review such differing interpretations and to bring them into unity with one another."

Engineering work has become an increasingly important factor in the progress of civilization and in the welfare of the community. That the dignity of their chosen profession may be maintained, it is the duty of all engineers to conduct themselves according to the principles of the following Code of Ethics:

1. The Engineer will carry on his professional work in a spirit of fairness to employees and contractors, fidelity to clients and employers, loyalty to his country and devotion to high ideals of courtesy and personal honor.
2. He will refrain from associating himself with or allowing the use of his name by an enterprise of questionable character.
3. He will advertise only in a dignified manner being careful to avoid misleading statements.
4. He will regard as confidential any information obtained by him as to the business affairs and technical methods or processes of a client or employer.
5. He will inform a client or employer of any business connections, interests or affiliations which might influence his judgment or impair the disinterested quality of his services.
6. He will refrain from using any improper or questionable methods of soliciting professional work and will decline to pay or to accept commissions for securing such work.
7. He will accept compensation, financial or otherwise, for a particular service, from one source only, except with the full knowledge and consent of all interested parties.
8. He will not use unfair means to win professional advancement or to injure the chances of another engineer to secure and hold employment.
9. He will coöperate in upbuilding the Engineering Profession by exchanging general information and experience with his fellow engineers and students of engineering and also by contributing to work of engineering societies, schools of applied science and the technical press.
10. He will interest himself in the public welfare in behalf of which he will be ready to apply his special knowledge, skill and training for the use and benefit of mankind.

The Joint Committee on Code of Ethics was composed as follows: Representing the A. S. C. E., C. C. Elwell, A. M. Hunt; representing the A. I. M. E., J. Parke Channing, Philip W. Henry; representing the A. S. M. E., A. G. Christie, chairman, H. J. Hinchey, Chas. T. Main, J. V. Martenis, Robert Sibley; representing the A. I. E. E. Comfort A. Adams, G, Faccioli, Geo. F. Sever, L. B. Stillwell; representing the A. S. H. V. E., Frank T. Chapman, S. A. Jellett, Perry West.

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# Advantages and Disadvantages of Licensing Engineers*

By B. B. GOTTSBERGER

Consulting Mining Engineer, New York City

I HAVE given considerable thought during the past year to the subject of licensing of engineers and particularly to the position which the mining engineer should take on this question. I have found, however, that it is not a subject which yields much result for the thought expended on it. So far as any published record will show, mining engineers have been either ignorant of the extent to which the movement for the licensing of engineers has progressed or else indifferent to it.

It is true that the Mining and Metallurgical Society of America, by a questionnaire sent out to its membership, did a great deal in calling this matter to the attention of the mining profession, and so far as I know, the report of its committee, which analyzed the replies received, is the only published statement of the feelings and opinions of our branch of the engineering profession. It is to be hoped that the conclusions shown by that report, namely, that mining engineers are almost unanimously opposed to the principle of licensing and consequently any legislation dealing with it, has received serious thought and that we are ready for an even more thorough consideration of the subject.

## Nineteen States Require Licenses

Up to the 26th of July, 1921, laws dealing with the registration of engineers had been passed in 19 states. Four of these did not attempt to cover the entire engineering field but dealt with restricted portions of it, such as structural engineering, civil engineering, and in one state, drainage, highway, state and municipal engineering. The principle, however, is the same, and the idea is certainly rapidly gaining strength, in certain quarters, at least, that the profession of engineering is one that for the protection of the public must be regulated by law.

In general, these laws provide that within a time limit stated in the act, engineers desiring to practice must qualify before boards of registration and obtain certificates showing that they are authorized to practice. The machinery for carrying out these laws consists of boards, variously known as state boards, for the registration, examination, of licensing of professional engineers, architects and land surveyors. After satisfactorily fulfilling the requirements set up by the board, applicants receive certificates of registration and are provided with seals which they are authorized to use on all reports and drawings prepared by them.

As the notice of this meeting which was sent out to the members would indicate, fees are charged for the privilege of registration, varying from $15 to $25 in amount, with the provision that an additional payment must be made upon the annual renewal of the certificate which is in most cases required. This fee is variously placed at from $1 to $10.

## Citizenship Required to Practice Engineering

I will not attempt to set out here any statement of the qualifications demanded by these laws as a preliminary to the issuance of a license, as this is rather an involved matter to summarize and as in the first instance each engineer is concerned most directly with the qualifications called for in his state of residence. I would, however, like to point out that in 11 states United States citizenship is required, on the face of it a most natural qualification, but one somewhat disturbing to the mining engineer when he thinks of the possible necessity of establishing his own qualification to practice in foreign countries. Once having successfully established his right to practice in his state of residence, the engineer is naturally interested to know to what extent his standing will be recognized in other states of our country. On looking into this question he will learn something not entirely pleasing to him. He will find that if legally authorized to practice in his own state he will be welcome for a period not to exceed 30 days in any one year in the states of Arizona, Minnesota, New Jersey, New York, North Carolina, Oregon, Pennsylvania, and West Virginia. The other 11 states will apparently have nothing to do with him until he has first made application for a local license and paid the necessary fee, although a few states, namely, Arizona, Minnesota, North Carolina and West Virginia, grant him the privilege of consultation with local registered engineers. For this so-called reciprocity feature to be operative, it is usually required that the local boards shall from time to time investigate the requirements for registration in other states and if they find that these are not lower than in their own states, the reciprocity clauses will be effective. Here arises the question of the standing of an engineer living in a state

* Address at meeting of New York Local Section, Jan. 11, 1922.

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where licensing is not required. There is no basis of comparison as to qualifications with those states having license laws although, as he is not forbidden to practice by law, apparently he would be considered qualified. To those doing business in New York state, it is of particular importance to know that the reciprocity clause applies only where a mutual agreement has been entered into by the regents of the University of the State of New York and the boards of examiners of other states, a provision which I understand the board of regents has not taken steps to carry out.

This is a very sketchy outline of the method of operation of registration laws, but of far more importance to my mind than the structure of the law is the question of the scope of its application. It is on this point particularly that thought on my part has yielded very meager results. After having read the definitions set out in those laws which attempt to draw a line around the field of engineering and to say who is and who is not an engineer, I confess myself very much at a loss. If my information is correct, six laws contain so-called definitions of engineering. The other states, as a rule, content themselves by saying "You shall not practice as a professional engineer unless licensed so to do." I find that these definitions can be roughly divided into three sets. I will give an example of each.

Florida, Iowa and Oregon consider the question covered by the following:

A person practices "Professional Engineering" within the meaning of this Act who practices any branch of the profession of engineering other than military engineering. The practice of said profession embraces the design and supervision of the construction of public and private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, wet docks, and other floating property, the design and the supervision of the construction of steam engines, turbines, internal conbustion engines and other mechanical structures, electrical machinery and apparatus, and of works for the development, transmission or application of power, the design and the supervision of mining operations and of processes and apparatus for carrying out such operations, and the design and the supervision of the construction of municipal works, irrigation works, water supply works, sewerage works, drainage works, industrial works, sanitary works, hydraulic works and structural works and other public or private utilities or works which require for their design or the supervision of their construction such experience and technical knowledge as are required in Section 8 of this Act for admission to examination. The execution as a contractor of work designed by a professional engineer or the supervision of the construction of such work as foreman or superintendent for such a contractor shall not be deemed to be the practice of professional engineering within the meaning of this Act, nor shall this Act apply to a person acting as a public officer employed by the state, county or municipality of this state, on work where the estimated cost of the same is $1000 or less.

Here, you will note, the mining engineers are brought within the fold by the words "the design and the supervision of mining operations and of processes and apparatus for carrying out such operations."

New Jersey and Pennsylvania have, to my mind, quite sensibly endeavored to draw up a definition in much more general terms, that for New Jersey being as follows:

Professional engineering as covered by this act means the practice of the professional engineer who through technical knowledge gained by education and experience in one or more branches of that profession initiates, investigates, plans and directs the application of the resources of nature to the use and convenience of man; and who represents himself or herself to be such an engineer, either through the use of the term engineer with or without qualifying adjectives or through the use of some other title implying that he or she is such an engineer.

It should be noted that this definition covers the field so thoroughly that one is apparently forbidden to call himself an engineer either with or without qualifying adjectives until he has been licensed.

Our home state contents itself with a still shorter definition as follows:

A person practices professional engineering within the meaning and intent of this article, except as hereinafter stated, who holds himself out as able to do, or who does, the work that an engineer does in the planning, designing, constructing, inspecting and supervising of engineering work, or appliances involved in public or private projects, or in making investigations for proposed engineering projects.

This at least has the advantage of brevity and it is consoling to be told authoritatively that after all an "engineer is as an engineer does."

After reading these definitions, it is evident that if they are to be taken seriously and at their face value, the intention is to prohibit the practice of any branch of engineering to those who cannot qualify under the laws.

Right here is where I think this subject calls for most careful study. I have no hope that a much more satisfactory definition of engineering would result from this, but I would hope that as engineers study their field and attempt to circumscribe it, or to make their field so broad as to be all-embracing, they will pause and consider whether, after all, they care to reserve this field entirely to themselves, and whether they wish to bar out from the consideration of the vast number of problems included under the term of engineering all who do not measure up to the arbitrary standard that they will finally set up as law.

I often wonder what a careful investigation of the origin of many things today considered commonplace in our industrial life would reveal when the credit for the first inception of the ideas was given to its proper source. I do not think that after this investigation engineers would finally feel justified in claiming all of the credit; and would they not have to acknowledge that today some of their most valuable tools came from those who, under the operation of these acts, would be forbidden even to think? I may as well say that my own most serious objection to licensing laws is not that some one unqualified to practice will be barred out for the benefit of the public, but that some other one, or many such, will be forbidden to develop their ideas because we would disown them as engineers.

Leaving this phase of the matter for the moment, let us assume that the arguments of those in favor of licensing are valid, and that the public stands in need of protection from the incompetent engineer. To what extent will the laws already enforced provide this needed protection? In other words, if the laws as drawn provide the safeguards needed, to what extent are they compulsory? In most cases it will be found

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that laws are apparently of universal application and that practice of professional engineering by unlicensed engineers is positively forbidden. In five states, however, namely, Arizona, Minnesota, Tennessee, Virginia, and West Virginia, licensing is, to a large extent, optional. It will usually be found that in the first section of the law the object of it is set out, and I quote as follows from that of Arizona:

> Section 1. In order to safeguard the life, health and property, any person practicing or offering to practice as an architect, a professional engineer, a land surveyor or an assayer in this state shall hereafter be required to submit evidence that he is qualified so to practice, and shall be registered as hereinafter provided, and from and after six months after this Act becomes effective, it shall be unlawful for any person to practice or to offer to practice in this state, as an architect, a professional engineer, hereinafter called engineer, a land surveyor or an assayer, except under the provisions of this Act.
>
> Section 2. Nothing in this Act shall be construed as requiring registration by an individual, firm or corporation for the purpose of practicing architecture, engineering, land surveying or assaying on property owned or leased by such individual, firm or corporation, unless the same involves the public safety or health; nor as requiring registration by any person who prior to the time of the passage of this Act was engaged in the practice of architecture, engineering, land surveying or assaying, provided, however, such person shall not represent himself as, or use the title of "Registered Architect," "Registered Professional Engineer," "Registered Land Surveyor," or "Registered Assayer" unless such person is qualified by registration under this Act.

Reading Section 1, it is the evident intention of the legislature of the State of Arizona to see that those committed to its care are guarded from incompetency and absolved from the necessity of using good judgment in the selection of an engineer.

What, therefore, are we to think when, in Section 2, we are told that any person in practice prior to the passage of this act may continue provided he does not use the title "Registered Engineer?" This provision, I am told, is the so-called Grandfather's Clause, based on the theory that the right to continue a gainful occupation cannot be taken away by law. It is evident, therefore, that if this proviso must also be extended to all of the states, there is no hope of reforming the practice of the engineering profession until those now in practice are displaced by the rising generation of qualified engineers. Personally I would not claim this to be a serious defect in the law if its necessity were fully established and I would probably applaud the thoughtfulness of engineers in looking so far ahead in endeavoring to carry out the ideals of their profession.

### Does Licensing Safeguard Public?

Assuming again the necessity of these laws, is the profession of engineering one that will be safeguarded thoroughly by the mere establishment by an applicant of his qualifications based on examination and a short period of experience? Possibly so, if engineers are to be classed as workmen carrying out specific tasks for which the necessary qualifications can be outlined. If, however, the real danger to the public should come, not through a lack of fundamental knowledge on the part of the engineer, but through his inability to use good judgment in the application of this knowledge, then I cannot see that the protection necessary is provided for by registration. Personally, I am so inclined to feel that the engineer should be willing to stand on his own feet and prove by his record that he is entitled to employment, that I find it hard to attempt to submit arguments justifying a demand for licensed legislation. I have so far seen nothing convincing in the way of an argument that demonstrated why the public needed this protection, and strangely enough, this question of the public welfare is the only argument I have found in favor of licensing. I have endeavored to find out what other arguments the advocates of this legislation have advanced.

As most of you probably know, the proponent of licensed legislation has been the American Association of Engineers. For some years past this Association has published an official organ, originally known as the *Monad*, and lately published under the title *The Professional Engineer*. Dating back at least to 1918, this Association has published the views of its members on the question and I have endeavored to learn from a study of it what the arguments in favor of licensing are. I confess I cannot submit at this time a complete digest of all of the views expressed, but I do not think I am unfair in making the following quotations:

> Now what is the object of such legislation? I believe the fundamental idea is, and should be, to protect the public, because if this protection can be afforded other equally desirable things will probably follow.
>
> Will a good license law do this? I think it will greatly improve present conditions, and eventually will be successful, granting that high standards be maintained. It is my opinion that the more recent laws give great promise.
>
> In addition to protecting the public, in what ways will these laws benefit the engineer? These ways occur to me.
>
> 1. By forcibly reminding us of our responsibilities.
> 2. By establishing us before the law as professional men.
> 3. As a result of the first two premises, we shall value our services better, and the services will be recognized as professional ones.
> 4. Eventually we shall have more "real" engineers, because we shall expect more of them.

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> Previous to its passage, a great many incompetent and ignorant men were calling themselves engineers and were getting work by making extravagant claims and offering to do work below the cost of doing it properly. This sort of malpractice has very largely ceased since the engineers license law became effective, though it has not entirely disappeared and probably never will.
>
> The general standard of the profession has been improved, as naturally was to be expected. For one thing, the law makes it possible to state definitely who is, and who is not, an engineer. As the standards of practice have been improved by exclusion of unworthy men, the public appreciation of the profession has been very naturally increased.
>
> The law licenses a man as a professional engineer without specifying any branch of engineering or limiting the man's practice to any one branch. This makes it legally possible for a man to obtain his license by passing examination as a civil engineer and then under it, to do electrical engineering work, or work in other branches with which he is not familiar.

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> What reasons are there for licensing? Like the ten commandments, one summarises all. Licensing can be justified by a profession on one ground only; namely, the benefit of the public; the protection of life, health and property. Any other attempted justification places the engineer on the plane of a tradesman advocating a closed shop, and while licensing has results directly beneficial to the professional engineer, these are incidental.

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These quotations appear to be typical of the few arguments I found in favor of the movement. You will note, however, that they are merely statements and that no actual instances of loss or damage to the public are cited in support of them. It seems to me that the case for and against licensing has been very well set out by the Joint Committee on Licensing of Engineers, which opposed the movement before the Massachusetts legislature and which represented a number of engineering societies and sections of national societies with headquarters in Boston, and I would commend this particularly to your attention. It will be found in the December issue of MINING AND METALLURGY. They have attempted to set out the arguments advanced by those favoring the law and it apparently again simmers down to the protection of life, health and property of the public without, however, much in support of the claim. Turning to their arguments against licensing, I am particularly impressed by the following:

> Prof. George F. Swain pointed out, at the hearing, in the clearest possible way, the character and the extent of the safeguard to the public that exist at the present time relating to the construction of buildings, public and private utilities, etc., through supervision by competent commissions and engineers, through building laws and other special laws requiring official supervision and approval of plans, inspection of work in process and of finished work, and expressed the opinion that if such measures were not sufficient the wise policy would be to add to them and to amend them in such a way as to cure their defects, but that no possible method of registering engineers could take their place or could provide a system of safeguards to society that was comparable with them in effectiveness.

From all this it must be evident to you that I am decidedly opposed to the licensing of engineers. I do feel, however, that if we decide to come out with active organized opposition to it, it will be necessary to consider carefully why the forces favoring this movement have been so successful in accomplishing their object in so many states of the union, and before committing ourselves to active opposition we should assure ourselves that we have ground for successful operations and that we may count on the support of our brother engineers.

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## Skull in Lead-Zinc Deposit in Rhodesia

WHAT is said to be the most important find in anthropology since the Piltdown skull is a human skull recently discovered during mining operations at the Broken Hill mine in Northern Rhodesia, which may prove to be a new link in the pedigree of mankind. It has been presented, by the mine operators, to the British Museum.

The skull was found 60 ft. below water level, at the foot of a "Bone-Cave," with other human bones, part of which were destroyed by the native laborers in their digging. These were the only human remains out of many hundreds of tons of bones that have been removed during mining operations. "Fossilized and partly fossilized remains of elephants, lion, leopard, rhino and hippo and many more animals and birds have been found, all of which were destined to pass through the smelter to obtain the metals which have replaced the lime of the bone; for chemical examination has shown that the lime has been largely replaced by the phosphate of zinc and lead." Before mining operations commenced, there was on this spot a kopje, or hill, 50 to 60 ft. high. Mining operations have demolished this hill and have excavated to the depth of over 90 ft. below ground level where the hill stood, and it was at this depth that the shull was discovered. The entrance to the Bone-Cave was at ground level. S. J. Speak, mining engineer of London, has given us the following interesting theory of the origin of this cave.

"It occurs on the edge of what was originally a sulfide orebody in dolomite, and there can be little doubt that the cave is a natural result of oxidizing and leaching action. The cave contained much debris, and had undoubtedly been used by cave dwellers as a home which they made no attempt to keep clean. The cave also probably possessed the advantage of access to water. We have now satisfied ourselves that water level was much lower in older times than it is now. The skull was found 60 ft. below present-day water level; at that depth we find it necessary to pump 6,000,000 gal. per day to keep our quarry open. The method of occurrence of the numerous bones is one of our evidences of a raised water level, but by no means the only one. Boreholes show some oxidation at depths of 300 ft. The topography of the district in no way suggests the cause of the raised water level. I have no doubt that the original drainage was by underground channels that have since been choked. There is an escarpment 1000 ft. deep about 30 miles away from the mine."

The skull has aroused a great deal of interest and has been discussed at great length by scientists. The Rhodesian fossil skull does not represent a type of man which is new to anthropologists; every feature of this skull proclaims the ancient African of whom it formed part to have been first cousin to Neanderthal man, that peculiar species of humanity which lived in Europe throughout a certain phase of the Ice Age.

We are indebted to Ross Macartney, the manager of the mine, for this information, through the courtesy of Mr. Speak.

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**The Miners' Safety and Health Almanac** for 1922 has been issued by the United States Bureau of Mines, in coöperation with the United States Public Health Service. This book, compiled by R. C. Williams, Passed Assistant Surgeon, U. S. Public Health Service, besides containing the usual fund of information concerning sun, moon, wind and weather, preaches crispily and snappily the doctrine of Safety First. It contains many articles by experts in safety, health and sanitation problems, and is intended for circulation among the million coal and metal miners and quarry workers in the United States. Copies may be obtained from the Bureau of Mines, Washington, D. C.

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# Correspondence and Discussion

## Copper at Retail

IN CONNECTION with the present cost of copper articles at retail, I had occasion to buy from a Pittsburgh hardware store some strip copper cut from 3/16-in. sheet. The price came to 33 cents a pound. Brass screws an inch long cost about 2-½ cents each from the same dealer, when bought in small quantities, such as a dozen or two.

These prices are not far from what one had to pay 10 years ago or when copper ingots and wire bars were quoted about as today.

MYRON R. WALKER.

Dormont, Pa., Jan. 20, 1922.

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## Northwest Mining Association's Position

MY NAME having been prominently displayed in your article in January MINING AND METALLURGY, concerning mining law revision and the present attitude of the Northwest Mining Association in respect thereto, as expressed in the resolutions and analysis of Nov. 19, 1921, I respectfully offer the following comments for what they are worth.

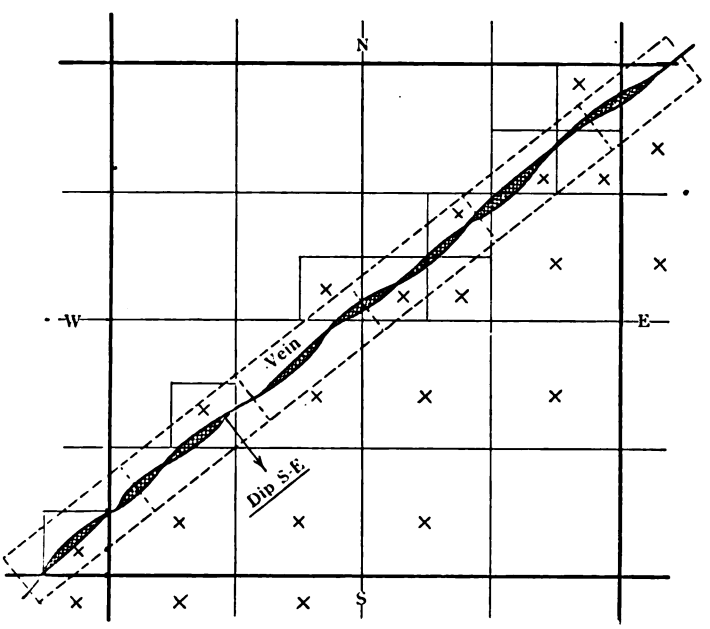
Permit me, first, to note the fact that circumstances often alter cases; also, that there may be a wide difference between a popular demand that something be done, and the opinions aroused by the final form in which it is proposed to do that something.

Again, that there may be a considerable difference between the casual opinions of a convention, which has been requested to endorse resolutions drawn and presented by outside parties, and the opinions of a special committee appointed to pass upon the provisions of a final bill apparently drawn to those resolutions.

Moreover, that there has been an almost complete change of feeling since 1916 in respect to legislation of any sort. All business has been so hampered and harassed by governmental regulations, changed laws and other conditions, that it is loudly crying for a rest, and the mining industry is no exception to the rule.

Finally, that while my name was probably signed to the resolutions of 1916, as president of the association at that time, yet I was not wholly responsible for them; even then I was beginning to doubt the wisdom of changing the extra-lateral right law—a doubt that has since become a conviction, at least as far as the United States is concerned.

Until recent years, I was a strong advocate of an abolishment of this extra-lateral right. Twenty-six years ago I spoke for an hour before a large convention, earnestly urging that immediate measures be taken toward an adoption of the British Columbia mining location; and in the analysis above mentioned, it is specifically implied that if the square location had been




SKETCH ACCOMPANYING RESOLUTIONS OF THE NORTHWEST MINING ASSOCIATION, NOV. 19, 1921.

Showing proposed method of locating mining claims under H. R. 7736, compared with the present system as indicated by the dotted lines. To possess a vein striking as above, and having a flat dip, the tracts marked "x" would be needed under this Bill.

proposed, having one side parallel to the strike of a vein and close thereto, there might have been less objection to the proposal. But to compel locations along the cardinal lines of the public survey would certainly prove impracticable and work much hardship and confusion, particularly on unsurveyed lands. I enclose another sketch in support of this contention.

However, I think that my reasons for a reversal of my former views on this matter are clearly stated in the said analysis and need not be repeated here.

Respecting locations without discovery, much might be said. As you have noted, it was conceded that some *well-guarded* right should be granted where, for instance,

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geological deductions point to the possibility of mineral although surface signs are absent, or nearly so. Since the bona fide prospector would probably not locate ground in the latter case, he would not be greatly concerned although the speculator might.

No suggestion was made as to *how* this right should be safeguarded because that was not considered to be the province of the analysis, which dealt only with the bill itself. Suggestions were not in order, yet it would seem that it should not be very difficult for competent legal talent to devise provisions that would discourage any but bona fide locators, something that certainly was not done in the present bill.

Regarding subdivision C, section 5, compelling location notices to be filed in the U. S. Land Office *only*, instead of at the county seat, I think that the objections were clearly stated in the analysis. A very important suggestion was made that duplicates of the filings made at the county seat should be also filed in the district land office.

The objection to an acceptance of cash in lieu of actual assessment work is also clearly stated in the analysis, although this may be a matter of opinion as well as of experience.

The mill-site clause was objected to because of the requirement that sites be located on cardinal lines, and not because of the proposed increase in acreage. You will recall that the objection was to the 'method' of location. There is no objection to an increase in acreage, I think.

In conclusion, it seems to me that your wholesale condemnation of the Northwest Mining Association, and myself personally, is unwarranted by the facts. Also, I question your right to challenge the right of any organization, or individual, to a change of opinion in the course of eleven, or even six, years. Much has happened since 1911 and more since 1916.

In reversing itself in the matter of the extra-lateral right, the Association has but answered the question, "What real good would it do, after all, to abolish this right *in the United States at this late day*, when virtually all mineral-bearing districts are already thickly plastered with locations that will hold under the present law? What harm might it work?"

Forty years ago, or even thirty years ago, such a change doubtless would have been a benefit; provided, always, that locations were not required to be made on the lines of the public survey. It would be very questionable today, as a careful study of the situation must show. *Hostility to the apex law has become a habit that has precluded such careful analysis.*

Therefore, I maintain that the present position of the Northwest Mining Association is not only tenable but that it is directly in the interests of the mining industry. Furthermore, its objection has been filed before the bill has passed and the reason has been clearly stated.

FRANK A. ROSS.

Spokane, Jan. 19, 1921.

## Eminent Authority in Favor of Mining Law Revision

YOUR article on the Revision of the Mining Law in the January MINING AND METALLURGY, is admirable. You may be interested to know that about twenty-six years ago, Judge Hawley, one of the most experienced and learned of the federal judges who have had to do with the interpretation of the mining law, expressed himself quite emphatically on the subject. In 1895, in the case of the Consolidated Wyoming Mining Co. v. The Champion Mining Co., 63 Fed. page 549, he expressed himself as follows:

> It would be an Herculean task to endeavor to fathom the complications that are liable to arise in the construction of this statute, and to provide for their solution on any refined method of interpretation. One thing, however, is certain: that unless it can be done, then the statute is radically wrong, and the sooner amendments are made thereto to avoid such difficulties, the better it will be for the mining industry of the country. In fact, it is a question worthy of consideration whether it would not be advisable to have the mining laws amended so as to adopt the Spanish, Mexican and Roman rules and give to the miners a greater width of ground upon the surface, making a square location, and confine the owner of the claim to the ground within the boundary planes of his location in length, width and depth, the same as agricultural land, so as to avoid any further conflict over side and end line propositions that are becoming such fruitful themes of endless dispute and litigation.

When a judge of wide experience refers to such disputes and litigation as endless, it may be taken for granted that he speaks out of fullness of knowledge and it makes one smile to read the assertions of men of no experience in such matters to the effect that all of the questions are settled. Those in possession of the real facts know full well that every decision or interpretation opens the door to other questions and that there are cases now before the courts in which are involved questions which have never yet been decided. In fact, I will cheerfully undertake to present ten or a dozen situations involving extra-lateral rights regarding which no two lawyers of the widest experience in mining will presume to state definitely what verdict would be given by the United States Supreme Court.

In an article entitled "The Relation of the Mining Law of the United States to the Development of its Mineral Resources" published in the *Mineral Industry* in 1894, Doctor Raymond, than whom no one was ever better qualified to speak, expresses his opinion as follows:

> Enough has been written, perhaps, concerning the curious, haphazard origin of our unique mining law and the innumerable disputes which its eccentric, vague, inconsistent and ill-considered provisions entail upon mine-owners—though, perhaps, all these things will need to be reiterated again and again before they will be realized by all parties whose coöperation is necessary to a radical reform.
>
> Enough has been written likewise, perhaps, concerning the object lesson presented at this time by the mining districts of the world, including the greater part of the mining industry of this country, in which mining litigation (in the sense of disputes over the boundaries of mining rights, otherwise held by perfect title) is unknown, while in certain of our States and

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Territories such litigation burdens the courts, oppresses the owners and operators of mines, and enriches only lawyers and experts. This lesson also may need to be enforced hereafter by repeated exposition; but only because of the slowness of the pupils who should have learned it long ago.

The full development of the mineral resources of the West will never come to pass until the capital it requires is better protected by definiteness in title and boundaries of mining property. And that cannot be done, in my judgment, by any amendment of the present law which shall leave in it the present abnormal, irregular, indefinable, precarious and mischievous "extra-lateral right."

The draft of an amended law was prepared by men who have had years of experience in the application of the present law, who have learned its defects and who have the interest of the mining industry at heart. This does not mean simply one end or portion of the mining industry, such as the prospector, the mine operator, the mining lawyer, the mining engineer or the capitalist. It means the industry as a whole. The criticisms of this bill, which have been voiced from time to time, represent largely one or the other of these special classes. The old-time prospector has largely disappeared and the prospecting of the future will be done mainly by men of large means, better geological knowledge and wider command of all the agencies for discovering ledges and deposits which do not prominently outcrop upon the surface. Most of the easily discovered mines have been found and developed and the annual labor which is performed under the requirements of the present law seldom accomplishes anything of value toward the discovery of new mines.

The locator of a mining claim regards the discovery requirement of the present law as a joke. He boldly sets his discovery monument upon the surface where the wash is 50 ft. deep, tells Uncle Sam that he has discovered mineral in place, stakes his claim and relies upon the generosity and spirit of good-fellowship of his neighbors not to jump his claim or interfere with his possession. The Land Department is assailed if it refuses to patent ground thus fraudulently located and by force of public sentiment or the individual influence of congressmen is coerced into granting patents for land upon which no single bit of valuable mineral in place has ever been discovered. Now, as a matter of fact, the locator is not secure in the possession of the ground which he has thus staked without a discovery and might be ousted by any other prospector who should locate across the territory already staked and first make a discovery. This frequently happens and land is acquired not at $50 per acre *annual rental* but in fee for $5 per acre in large quantities.

The framers of this bill desired to make it possible for the locator of mineral claims upon the public domain to be honest and preserve his self-respect and remain secure in his possession of the ground whereon he desires to prospect before he has made a discovery and to give him ample time to discover mineral. They desired also to make sure that mines are discovered if possible and therefore limited the time within which such land may be held to what seemed to them to be a reasonable period. If five years is not long enough, we are perfectly willing to make it longer but it is seldom indeed that a serious, energetic prospector will desire to hold a piece of ground without the discovery of anything valuable for more than five years. Speculators and men who do nothing to develop the mineral resources of the country are the only ones likely to do so and against them this limitation is directed.

However, you say quite truly that the committee that was asked to give its unremunerated time to the framing of this bill does not intend to engage in any propaganda for its adoption. The movement arose through a general and spontaneous demand for revision along certain definite lines and the bill is framed to meet this demand. If now the criticisms of uninformed individuals, inspired mainly by self-interest, is to prevail upon Congress to reject it, we shall have nothing further to say.

HORACE V. WINCHELL.

Los Angeles, Jan. 11, 1922.

## Licensing a Farce in Colorado

THE licensing law for mining engineers is getting to be more or less of a farce in Colorado. From Sept. 17 to 22, I attended a meeting of the licensing committee of the F. A. E. S. in Chicago to amend the model mining law issued by it, and that meeting afforded both mental and physical perspiration, due to the attempt to define engineering in a hurried heated atmosphere.

We in Colorado are not in sympathy with the general principle of licensing mining engineers. At the close of the 1918–19 session of the legislature, the bill was introduced for the purpose of licensing engineers, by a local branch of the American Association of Engineers, in an underhanded secret manner, without notice to any of the members of the several national engineering societies, and was passed by the legislature. This law was defective in many ways and, at the last session of the legislature, the Engineering Council of Colorado appointed a committee to revise it, and the present law was enacted as the result of such effort.

The so-called "grandfathers" clause permits those practicing engineering to continue to do so without examination, and by so doing, many men wholly unqualified to be called engineers, by the payment of a fee, receive their license, thus lowering to a deplorable extent the standing of those fairly entitled to be so designated.

The local section of the A. I. M. E. discussed the law, and the consensus of opinion was, and still is, that while there might be justification for the licensing of civil, sanitary and construction engineers, there was little, if any, benefit to be had by licensing mining engineers. The development and operation of coal mining has been well and favorably covered by existing laws, as to the safety of life and property, so that there was no need of this law to cover their requirements.

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The law has not been strictly enforced; if it were, it would adversely affect the mining interests in this state, because the small mine and its development could not afford to employ a licensed engineer, as an intelligent foreman could easily plan the necessary mine development; this I know from actual contact with such conditions; in one case, a man was running an upraise to reach an orebody exposed on an upper level, while in another, the work consisted of running two drifts on ore; there being in the one case, six, and in the other case, eight men employed. There is no question that these foremen were exercising engineering judgment, and as such were subject to the law. Those financing these operations could not afford nor did they need to employ a licensed engineer. In larger enterprises, the companies find it to their best interests to employ a competent engineer, and so far as licensing is concerned, whether or not these company engineers are licensed, is wholly academic.

In conversation, Robert J. Grant, the Examiner of the State Board representing the mining engineers, stated that the examinations he held—and they were very few—were of no real value, the applicant usually being uneducated in an engineering sense. A questionnaire had been prepared by a professor at Golden School of Mines, but it was found too technical for use with the applications. Recourse was thus had to oral examinations, and in view of the number of "grandfather" engineers then practicing, it was hard to refuse the applicant. The wide range of scientific knowledge involved in the various branches of the mining profession rendered it difficult to decide whether or not the candidate was fitted to be licensed. Once given a certificate as a licensed engineer, there was no field of engineering in which he might not engage, be it civil, electric, sanitary, construction, irrigating or mining; hence the safety of life and property expected through the enactment of the law was jeopardized. Mr. Grant is wholly against the principle of licensing mining engineers, for the reason that no good is obtained thereby and it only results in another useless law added to many others found impractical.

There are over eight hundred licensed men in this state, the fees from whom, the first year, amounted to over $12,000. The cost of the State Examining Board was only a few hundred; this year the income to the state is over $4000, with expenses about the same. This money is taken from professional men who have, at least in this state, suffered greatly from lack of employment, and who have in no way benefited by the payment made. If the surplus funds from the Licensing Board were applicable to some purpose useful to engineers, the feeling in the profession might be more kindly disposed towards the law, but the money goes to the general fund and is of no service to them. Here, we could well use it in maintaining a scientific library by the purchase of books and employing a librarian, or it could be usefully employed in aiding scientific research on the complex ores of the state, the oil shales, or developing some use for the rarer metals resulting from smelting operations; as, for instance, there are over a thousand pounds of thallium in the yard of a local smelter, for which there is no sale. Scientific research and investigation of the possible uses of this metal might result in knowledge of great scientific value.

I trust that the foregoing statement is sufficiently clear to give you a fair understanding of the Colorado situation. RICHARD A. PARKER.

Denver, Dec. 23, 1921.

## Licensing Advocates on the Wrong Foot

WRITING as a former member of the A.A.E., I will say that I am absolutely out of sympathy with the efforts of this organization to secure license legislation. That I am not alone in this attitude, I know, from conversations with other members last summer.

Mr. Ingalls has summarized many of the objections to such legislation so ably, in MINING AND METALLURGY for February, that little more can be said from the point of view of the general public.

I do not wish to be understood as minimizing the economic disabilities of the average subordinate engineer, but I fail to see how licensing is going to ameliorate these conditions in the least.

The A.A.E. has simply gone off "on the wrong foot" in this matter, and there is a strong possibility that, in chasing this phantom, sight may be lost of the possibilities for real service through the employment bureaus, and through classification boards in those most notoriously underpaid lines of engineering effort, railways, state and municipal employ.

Lest my statement that I was "formerly" a member of the A.A.E. should convey any false impression, I wish to say that I resigned this year, feeling that in my present rather isolated location, the employment and other services of the A.A.E. could be of very little use to me; and not from any dissatisfaction with the conduct of the affairs of the Association.

HARLAND M. KERSCHNER.

Timmins, Ont., Feb. 19, 1922.

## February Mining and Metallurgy

OWING to some unexplained inadvertence in the bindery, some of the numbers of the February MINING AND METALLURGY have signatures of 16 pages misplaced, which brings some of the advertising section into the middle of the magazine and some of the editorial section among the advertising pages. Perfect copies of the magazine will be sent to all who receive these imperfect copies and who will notify us. This explanation is offered to anticipate any criticism that might arise from a first-impression misapprehension.

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# Abstracts of Institute Papers

The following papers were presented at the New York Meeting, Feb. 20–23, 1922. They will be printed in full in the TRANSACTIONS.
A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 22 of the Advertising Section. Discussion of papers is invited.

## Future Demands on the Oil Industry of the United States

BY JOSEPH E. POGUE, NEW YORK, N. Y.

IN 1920, 531 million barrels of crude petroleum were consumed in the United States. As imposing as this figure is, the fact that the domestic consumption of crude petroleum has increased at an average rate of 10 per cent. a year for the past decade is more striking. Will this rate of increase in demand continue? If so, the year 1930 will call for 1260 million barrels of petroleum—a staggering volume. On the other hand, may we expect the demand for petroleum to grow as rapidly as it did when the automotive industry was having its most phenomenal expansion? If not, to what extent will the growth of oil requirements decrease? When and to what degree will the petroleum industry become affected by the economic law of diminishing returns? Obviously, this matter requires careful analysis, especially as both national and industrial planning must be predicated upon present estimates of the requirements of the future. The purpose of this paper, accordingly, is to project, as closely as present limitations of knowledge permit, the course of the demand for petroleum in the United States over the next 10 years.

Fortunately, there are several scientific methods of approaching the problem, centering around a study of rates of industrial growth, which lend considerable hope that the requirements of the immediate future in this field may be approximated with sufficient closeness to have practical value as a basis of action.

The demand for crude petroleum is the result of the demands for the products made jointly from this substance—gasoline, kerosene, gas and fuel oil, and lubricating oils. The demands for these have grown at different rates, as shown in Fig. 1, which depicts the domestic consumption of the four major products for all years for which there is a statistical record. On this chart, the slopes of the curves are proportional to the rates of growth, and the demand for crude petroleum is thus analyzed into its component parts. Gasoline has become the leading product, setting the pace for the quantity of crude petroleum needed.

Having observed the degree to which the domestic consumption of gasoline is outdistancing the other petroleum products in point of growth, we may examine the relationship that obtains between gasoline and crude petroleum, keeping clearly in mind that we are concerned with relative rates of growth, not absolute magnitudes. For this purpose, it is desirable to separate the supply of crude petroleum into domestic production and imports, and to plot against these factors the domestic production of gasoline. The growths of these three important items are compared, in Fig. 2 (not shown), and to facilitate comparison the figures representing domestic production of crude petroleum are divided by 5 before plotting. This not only lowers the curve (without affecting its slope) to a convenient position on the chart, but it makes it possible for the curve

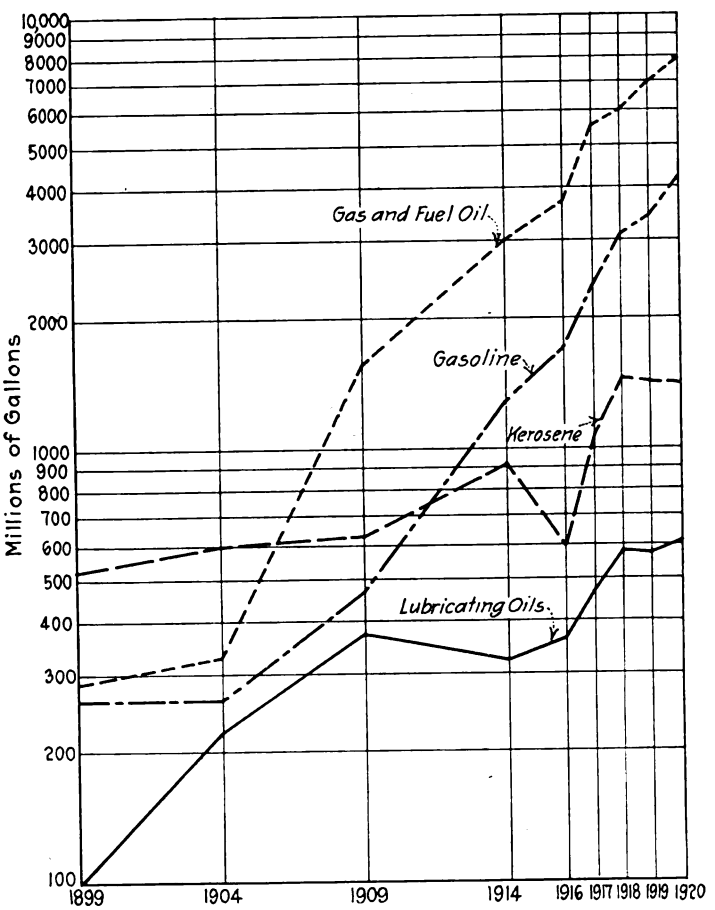


FIG. 1.—RELATIVE RATES OF GROWTH OF DOMESTIC CONSUMPTION OF PRINCIPAL PETROLEUM PRODUCTS, 1899–1920, SHOWING DOMINANT GROWTH OF DEMAND FOR GASOLINE.

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to depict both the output of crude petroleum and the approximate natural-gasoline content of this output.

The rates of growth of the curves in Fig. 2 may be accurately determined by the method of least squares. The point to be especially noted is that the domestic production of crude petroleum has been increasing at an average rate of 7.6 per cent. a year; the domestic production of gasoline, 21.87 per cent. a year; and the imports of crude petroleum, 72.3 per cent. a year. If this country should continue to import crude petroleum at this rate, the imports for 1930 would be 50.3 billion barrels! Such a statement, of course, is of value merely to emphasize the abnormality of the rate that has characterized the development of the Mexican fields over the past decade; such a rate cannot be maintained for any extractive industry.

Fig. 2 shows a second important relationship, the turning point in the economic status of gasoline that came in 1917, approximately. Prior to 1917, the quantity of crude petroleum produced in the United States contained more gasoline than was required. Since then, the natural gasoline-producing capacity of the domestic output has fallen behind motor-fuel requirements to the degree roughly expressed by the angle between the two curves in Fig. 2. The gap has been filled by imports and a factor that may be designated "new technology," by which is meant cracking, casing-head gasoline, change in end point, etc.

## Empiric Methods of Forecasting Demand

The simplest method of estimating future demand is by projecting current trend into the future. Thus, consumption for a recent period, say the past 10 years, may be plotted, an equation calculated that gives a good fit to the data, and the future consumption for any given date calculated therefrom. Such equations are empiric, determined wholly from the data in the past, and are unreliable for extrapolation beyond the limits of the observations. Empiric methods have the prime advantage of eliminating the personal equation; the results are identical, irrespective of the investigation.

The annual consumption of crude petroleum in the United States for the 10-year period, 1911–1920, are given. The increasing quantity of crude petroleum consumed may be interpreted as an arithmetic growth or else as a geometric progression of even or accelerating rate. First a straight line, then a compound-interest curve, and finally a parabola were fitted to the data by the method of least squares, the equations of these curves determined, and extrapolated values for 1925 and 1930 calculated. The results are given in the straight-line and compound-interest curves shown in Figs. 3 and 4. (Fig. 3 not shown here.)

The domestic consumption of gasoline for the years for which accurate statistics are available is shown. By fitting a straight line to the data by the method of least squares, extrapolated value for 1925 and 1930 may be obtained.

The domestic consumption of kerosene (Fig. 1) displays a recent rate of growth sharply at variance with that of the other petroleum products. For the period 1918–1921, the trend of this item has been downward. Whether this downward trend is temporary or permanent remains to be seen. Accordingly, a straight line has been fitted by the method of least squares, first, to the whole period 1916–1920, and second, to the last three years of that period when the trend was downward.

The domestic consumption of lubricating oils for the period for which accurate statistics are available is shown together with extrapolated values for 1925 and 1930 determined by fitting the equation of a straight line to the data by the method of least squares. As the consumption of lubricating oils is made of two components, industrial oils and motor oils, each growing at different rates, the empiric method of projection given is not apt to yield reliable results.

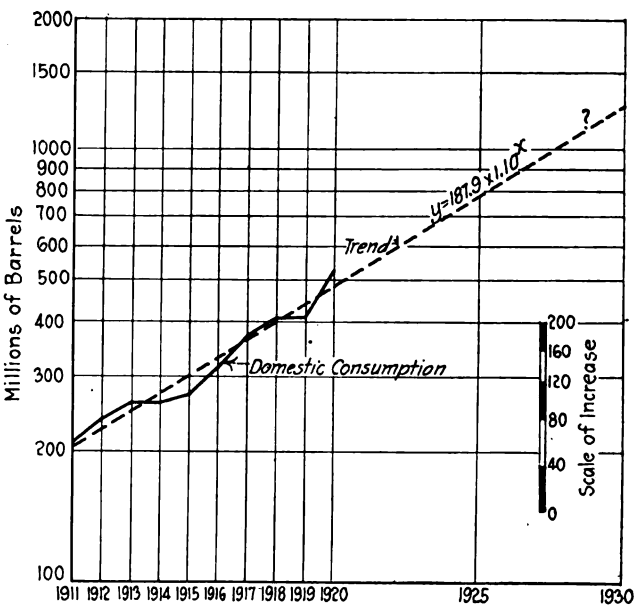


Fig. 4.—Empiric projection of demand for crude petroleum in United States determined by fitting a compound-interest curve to data by method of least squares.

The objection to empiric methods of projection is that, while the results may closely correspond to subsequent conditions, again they may not, and there is no way of telling in advance their reliability in any particular instance.

## Rational Methods of Forecasting Demand

It is the writer's opinion that for the problem in hand, the straight-line projection is more reliable than either the compound-interest curve or the parabola; but that results so obtained must be used with extreme caution, and that, on the whole, empiric methods do not offer a satisfactory solution of our problem.

Although future requirements may be estimated by projecting observed rates of change, by appropriate

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mathematical methods, no allowance is made for modifying influences that may affect the projected rates of growth. Can such allowance be made scientifically? Can we utilize past data and at the same time introduce factors drawn from outside the data, so as to arrive at sounder results than may be gained from the relatively simple methods thus far reviewed? Fortunately, there are rational methods that hold some promise in this connection.

An estimate of the growth of motor-vehicle registrations to 1940 was recently worked out on the basis of an assumed car density for that year and the results plotted as a projected curve. The projection was calculated by observing that in 1919 the car density in California was one car for every 6.07 persons, in Iowa one car for every 6.12 persons, and in Nebraska one car for every 6.54 persons; assuming that in 1940 there would be one motor vehicle for every 5 persons, the total number of vehicles being equally divided between passenger cars and trucks; making use of the projected curve of population as worked out by the engineers of the New York Telephone Co.; and plotting a smooth curve from the observed data of 1910–1919 to the year 1940, so as to reach the assumed ratio of vehicles to population on that date. The purpose of the investigation was not to forecast results for so remote a period as 1940, but to obtain workable figures for a few years ahead. The theory is that if the assumption of the ultimate ratio is made for a date far enough ahead, even a material error in that assumption would not seriously alter the forecast for the next few years.

According to this projection, there will be in use in 1925 approximately 10,000,000 passenger cars, and 5,100,000 trucks; and in 1930, about 12,200,000 passenger cars and 9,200,000 trucks. If we multiply the number of cars by the average annual consumption of gasoline per unit and make a similar calculation for trucks, we will arrive at an estimate of automotive-fuel requirements for 1925 and 1930, as shown in Table 12 as follows:

(*In millions of gallons*)

| Year | Estimated Consumption by Passenger Cars | Estimated Consumption by Trucks | Estimated Consumption by Cars and Trucks |
|---|---|---|---|
| 1925 | 3,350 | 5,100 | 8,480 |
| 1930 | 4,087 | 9,200 | 13,287 |

The calculation as given above, while having points of interest, is subject to criticism.

R. B. Prescott, of the Class Journal Co., has applied to economic data a formula devised some years ago by Gompertz and well known in actuarial work, which involves the principal of growth at a diminishing rate; or in other words the principle of diminishing returns.

The registrations of motor vehicles in the United States by years for the period 1912–20 are shown on a semi-logarithmic scale in Fig. 7. To the registration figures is fitted a curve of the type, $y = ab^{cx}$, which is projected to 1930. This curve, which is published by permission of Mr. Prescott, is thought to represent the trace of the normal growth of the automotive industry, and, if so, affords a rational basis for forecasting not only future demand for motor vehicles but the future requirements of motor fuel. Curves of this type have been tested on pig iron, potatoes, population, wheat, sugar, steel, railroad mileage, and cotton; and it has been found that the equation, fitted to data up to 1900, when extended to 1920 gave extrapolated values for 1920 corresponding to the actual figures within errors of 0.2 per cent. While the application of this technique is still in its developmental stage, the method gives promise of becoming a useful tool for predetermining the normal growth of industrial activities and market requirements.

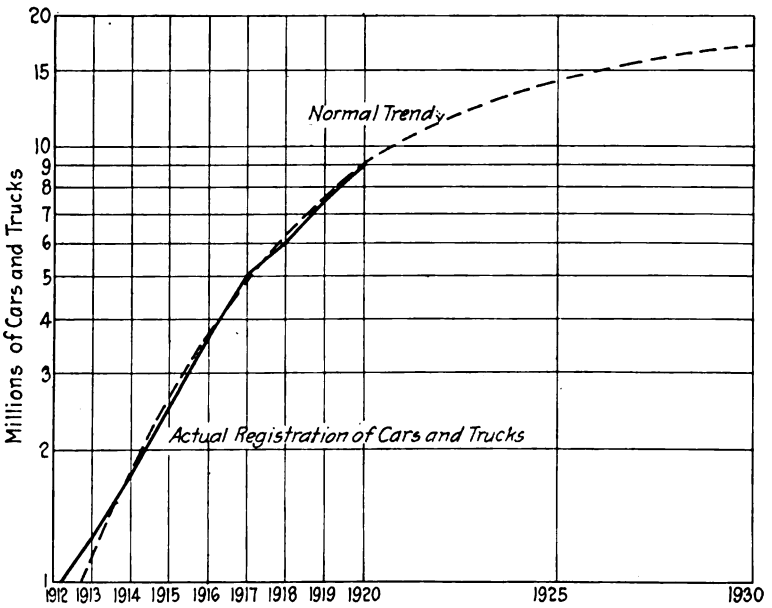


FIG. 7.—PROJECTION OF MOTOR-VEHICLE REGISTRATIONS IN UNITED STATES BY MEANS OF PRESCOTT FORMULA INVOLVING PRINCIPLE OF DIMINISHING RETURNS.

The projection of motor-vehicle registrations, as shown in Fig. 7, indicates clearly that the further growth of automotive transportation will be at a decelerating rate. The projection of the registration figures in this manner gives 14,400,000 motor vehicles (cars and trucks) as the probable number for 1925 and 17,500,000 as the probable number for 1930.

These extrapolated values may be converted into gasoline by multiplying them by the average gasoline consumption per unit (assuming that the consumption factor will not change materially); or else by fitting the normal registration curve to the curve representing domestic gasoline consumption and taking the trace of the former as the probable future course of the latter. The second method projects the ratio between motor vehicles and domestic gasoline consumption and

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therefore yields figures representing total consumption, instead of the consumption of cars and trucks alone. The results of the two methods are given in Table 13.

TABLE 13.—*Estimated Consumption of Gasoline (And Other Motor Fuels) in United States in 1925 and 1930, Based on Application of Prescott Formula to Automotive Registrations*

| 1 Year | 2 Number of Motor Vehicles, Millions of Units | 3 Consumption of Gasoline[a] by Cars and Trucks, Column 2×400, Millions of Gallons | 4 Consumption of Gasoline[a] by Cars, Trucks, Tractors, etc., Projection of Ratio, Millions of Gallons | 5 Difference, Column 4 minus Column 3, to be Credited to Tractors and Miscellaneous Uses, Millions of Gallons |
|---|---|---|---|---|
| 1925 | 14.4 | 5760 | 6800 | 1040 |
| 1930 | 17.5 | 7000 | 8300 | 1300 |

[a] Gasoline should be read in this table as gasoline and other motor fuels.

Several refinements, theoretically, are possible with this method, but accurate statistical data are available for such a brief period as to render preferable the indirect graphical method shown above. Accordingly, it seems better to let the investigation rest for the time being with the generalized results given in Table 13.

### SUMMARY OF THE SEVERAL METHODS OF FORECASTING GASOLINE DEMAND

A comparison of the results of projecting the future gasoline requirements of the country by the three methods outlined is given in Table 14.

TABLE 14.—*Comparison of Estimated Future Demand for Gasoline in United States (In millions of gallons)*

| | 1923 | 1925 | 1930 |
|---|---|---|---|
| Straight-line projection | 6,101 | 7,347 | 10,462 |
| Vehicle to population ratio | 5,748 | 8,480 | 13,287 |
| Prescott formula | 5,900 | 6,800 | 8,300 |

It will be noticed that while the methods yield widely different results for 1930 they are in reasonably close agreement for 1923. This concordance for the nearer date speaks for the practical value of mathematical methods of projection in general. Emphasis should be again laid on the fact that the need for accurate estimates is greater for the next few years than for a period 5 to 10 years ahead, and all three methods meet this important criterion. The projection by the Prescott formula, however, is given as the most probable estimate of future demand and one that may be used as a working basis for long-range planning.

### CONCLUSIONS

1. The demand for crude petroleum for the next 10 years will be determined by the growth of automotive transportation and the motor-fuel requirements resulting therefrom.

2. Future consumption of crude petroleum and its products may be estimated by methods of empiric projection, and the results attained by such methods are given, but such methods are not regarded as satisfactory.

3. Two rational methods of forecasting the demand for gasoline are described and applied, and a method involving the principle of diminishing returns is advanced as the most satisfactory approach to the problem.

4. By means of the method involving the principle of diminishing returns, the domestic demand for gasoline is estimated to be 6800 million gallons in 1925 and 8300 million gallons in 1930.

5. The ratio between the quantity of crude petroleum consumed and the quantity of gasoline produced is empirically projected, by fitting a straight line to the data by the method of least squares, and according to this method 27.7 per cent. of our crude petroleum consumption will be converted into motor-fuel service in 1925 and 33.9 per cent. in 1930, as contrasted with a percentage of 19.9 for 1920 This projection is subject to a greater probable error than the estimate of gasoline requirements.

6. Combining the results mentioned in the two preceding paragraphs; the estimated demands for gasoline in 1925 and 1930 are converted into demands for crude petroleum. The results attained indicate that 585 million barrels of crude petroleum will be sufficient to support automotive transportation in 1925 and 580 million barrels will be sufficient for 1930, on the basis of a continuation of recent progress in technology.

7. The results attained are subject to more accurate determination on the further development of the methods followed, but the present results are advanced as having sufficient probability to be of practical value as a basis of present planning.

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## Spies Open-stope System of Mining*

BY S. R. ELLIOTT, ISHPEMING, MICH.

The Spies mine near the village of Iron River, Mich., is operated by The Cleveland-Cliffs Iron Co. The jasper hanging walls of most of the deposits in the Iron River district dip at a steep angle and are strong, standing without caving, even after mining has been continued for years and after large excavations have been made. The ore is hard and tough and contains no slippage faces. It occurs in large masses, often egg shape, with the smaller end down. It can be mined in open stopes without the use of timber. The Spies system was developed to utilize the advantages of the open-stope method and to avoid the disadvantages of the shrinkage stope.

The Spies shaft was sunk to such a depth that the bottom, or third level, was in rock at a short distance

* This is the entire paper, not an abstract.

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below the bottom of the orebody, the shape and extent of which had been previously determined by diamond drilling.

In order to provide the necessary mills and raises, three parallel crosscuts were driven on 25-ft. centers on the bottom level. Drifts on the second and first levels were driven to the orebody and followed the foot wall in a southerly direction to the end of the ore. In crosscut 3, Fig. 1, raises 30, 40, 50, and 60 were carried up on the foot wall and holed into the second level, and ultimately carried up and holed into the first level. These foot-wall raises carry the pipes and ladders, provide a means of ventilation, and furnish safe communication to all working places in the stope.

From crosscuts 1, 2, and 3, raises were completed to a height of 32 ft., or the elevation of the first sublevel. They were then connected by east and west crosscuts to the main foot-wall raises 30, 40, 50, and 60, shown in Fig. 4. The crosscuts in raises 1 to 5 were then driven west and the hanging wall located. While this work was in progress, raises 1 to 5, 10, 12, 14, 16, 18 were driven until they reached the hanging wall. At intervals of 22 ft., the raises were connected by east and west crosscuts and the hanging wall to the west was located at the elevation of each sublevel. This is shown in Fig. 2.

Below the 639-ft. sublevel raises 1 to 5 were coned to an angle of about 45° to serve as mills. Miners then started in each crosscut on the 639-ft. sublevel, at points near the hanging wall and made fan-shaped holes toward the same. By repeating this operation on sublevels at higher elevations, the ore was cut away from the hanging wall and a narrow opening existed over the mills in crosscut 1 for the length and height of the orebody. From this time on, to the completion of the stope, the work was straight mining. Miners set up their machines in the various crosscuts at a safe distance from the edge of the open stope and drove holes pointed fan-wise toward the west, care being taken to pull back the east face in a vertical plane.

If one could stand against the hanging wall at a point opposite the center of the stope and look east, this face would resemble, in prospective, a number of pyramid-shaped funnels in a horizontal position, the larger end pointing toward the observer, the crosscuts being the spouts. This is shown in section and elevation in Figs. 5 and 6. While stoping is being continued, it is necessary to complete additional raises and to do crosscutting at higher elevations, or in parts of the orebody farther east.

### Disadvantages of the Shrinkage Stope

1. In a shrinkage stope, after mills have been made, the orebody is undercut. By setting up the machines on the broken ore and working around the perimeter of the stope, its height is increased until the top of the deposit is reached. After each blast, only sufficient ore is drawn from the mills to make room for the miners to work. A safe rule to follow is to have the back above the point where the machines are set up close enough for it to be touched by a miner when his arm is extended. With this precaution, it can be readily trimmed. Further, miners should not be premitted to go out toward the center of the stope, but should be kept close to a solid wall. Observing these rules, and always working around the perimeter, causes large orebodies to remain in the center of the stope which either must be blasted, by the use of long drills, or if they cannot be reached, must be left until they become so heavy that they will fall because of their weight. In time, these large massse are drawn down to the mills, when they must be broken by men who enter the mills from the bottom to drill and blast them; this is slow, expensive, and exceedingly dangerous work.

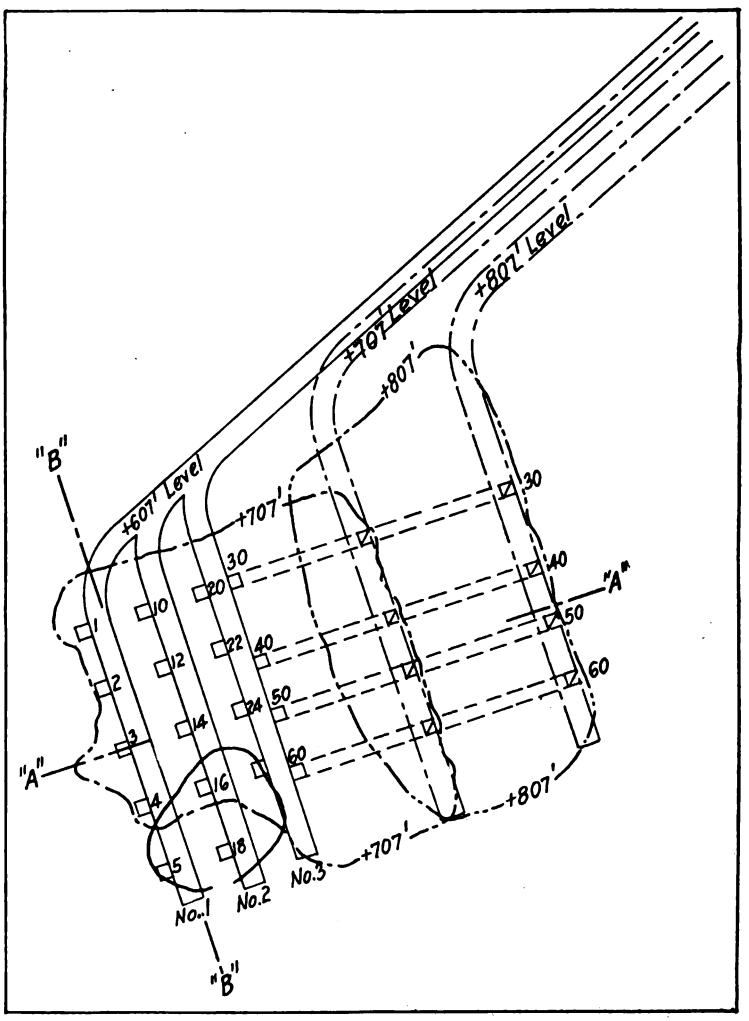


Fig. 1.—Plan of Spies Mine, showing main levels, contours of orebody, raises and mills.

2. As the ore is broken in a shrinkage stope, only about one-third of it can be drawn out of the mills. The pile in the stope must constantly be increased in

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height until the top of the deposit has been reached and the stope completed. A large investment, represented by two-thirds of the broken ore, is tied up until the stope is completed.

3. The miners spend a large proportion of their time trimming the back, trying to make it safe; their drilling efficiency is, therefore, low.

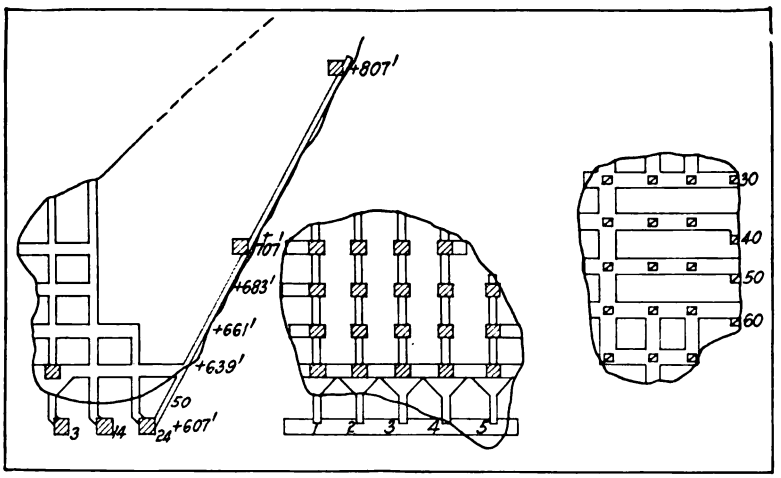


Fig. 2. Fig. 3. Fig. 4.

Fig. 2.—Section A–A before stoping is begun.
Fig. 3.—Section B–B before stoping is begun.
Fig. 4.—Plan of 639-ft. sublevel.

4. In drawing sufficient ore each day to keep the top of the pile at the proper distance from the back, there is constant danger that the ore will not settle properly and later on will surge and endanger the lives of the men in the stope.

5. If seams or bunches of rock are encountered, they must be broken with the ore; there is no means of separating the material.

6. Ventilation, as a rule, is poor and much time is lost after each blast.

### Advantages of the Spies System

The advantages of the Spies system compared in the same order as the disadvantages of the shrinkage stope enumerated are:

1. All men are provided with a safe and easy traveling road to their working places. There is every opportunity for miners to drill their holes with a proper burden on them, so that it is unnecessary to break the ore in large masses. It is not necessary to go up into mills to drill and blast. These are the chief factors that make it possible to obtain low cost by the use of this system.

2. All of the ore broken each day is drawn from the mills, only enough being left to protect the stopers from the shock of falling ore blasted in the stope. An accurate check can, therefore, be kept on the miners and high efficiency obtained.

3. No time is lost in trimming. The men are in no danger from falls of ground so their time is spent in drilling and blasting; their efficiency, therefore, is much higher than in the shrinkage stope.

4. There is no danger that the ore upon which the men are standing will be drawn from under their feet as they work in crosscuts with solid ore below them. Their machines are set up on posts, which is preferable to using tripods on loose ground.

5. During the development work in the sublevels, all seams of rock in the ore are outlined and can be mined before the stope has reached that locality, the rock being dumped into raises that are not being used as mills. It is possible, therefore, to mine the ore and keep it clean.

6. On account of the large number of small raises and the connections with upper levels, no trouble is experienced with ventilation. Blasting can be done at any time during the shift and only a few minutes lost. The area of the open stope soon becomes so large that the gases are rapidly dissipated and pass off through the upper levels.

With the exception of a small thickness of ore left above the first level to support the overburden sand, the stope in the Spies is completed. In this mine, on a comparatively narrow orebody, we have also worked the shrinkage-stope method, and therefore have had an opportunity to make a close study and comparison of the two systems. Our records show that the cost of breaking ore was about 4 per cent. higher in the shrinkage stope than where the Spies system was used. From every point of view, the Spies system has proved more satisfactory than the shrinkage stope.

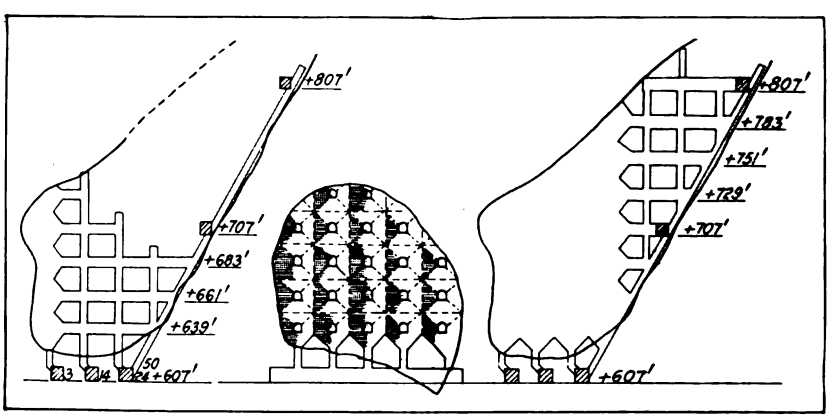


Fig. 5. Fig. 6. Fig. 7.

Fig. 5.—Section A–A after stoping is begun.
Fig. 6.—Elevation B–B.

**The Fertilizer Industry** has invested in plants, mines, materials, goods and accounts about $300,000,000, not including byproduct-plant investments.

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# Personal Notes and Biographies

**James A. Lane** is sales manager in New York for the Stimpson Equipment Co., Inc.

**George J. Porter** is project engineer with the New Mexico State Highway Commission.

**W. E. Thorne,** who spent part of last year in Europe and Africa, is at home for a short vacation.

**George G. Fleming** is production planning manager with the G. & J. Tire Co., Indianapolis, Ind.

**Bradley Stoughton** has been elected president of the Yale Engineering Association.

**A. B. Needham** has accepted a place on the engineering staff of the Butte & Superior Mining Co., Butte, Mont.

**John Stansfield** recently returned to England. His address will continue to be 115 Edmund Road, Hastings, England.

**Melvin M. Garrett,** recently with the Sinclair Oil Co. at Tulsa, Okla., is now with the Hobbs Oil Co., in Wichita Falls, Texas.

**E. J. Schrader** is making an extended visit in St. Paul, Minn., recuperating from an illness that followed an accident to his eye in the latter part of last year.

**W. H. Wright** is superintendent of the Compañía Minera Chocó-Pacífico, Andagoya, Colombia, S. A. The company is dredging for gold and platinum.

**D. M. Drumheller, Jr.,** returned to the Tidewater Copper Co., Sidney Inlet, B. C., as general superintendent, when that company resumed operations early in February.

**L. M. Kniffin,** formerly manager of the Hanover Bessemer Iron & Copper Co., at Fierro, N. M., is now with Madeira Hill & Co. as development engineer, at Frackville, Pa.

**L. G. Donnelly** has withdrawn from the firm of Brokaw, Dixon, Donnelly, Garner & McKee, geologists and petroleum engineers. The firm will hereafter be Brokaw, Dixon, Garner & McKee.

**Kenneth Williams** has been appointed metallurgist at the Copper Queen smelter of the Phelps-Dodge Corporation. He was formerly general foreman of reverberatory furnaces and roasters at that plant.

**S. F. Shaw,** manager of the Compañia Minera La Constancia in Sierra Mojada, Mexico, is now also superintendent of the properties controlled by the Compañia Minera de Peñoles, in the same district.

**L. K. Armstrong and John C. Semple,** by mutual agreement, have dissolved the partnership of Armstrong and Semple. Mr. Semple has opened offices in the Shoshone Bldg., Wallace, Idaho, for consulting work.

**Colin G. Fink,** electrometallurgist, has opened a consulting office at 101 Park Ave., New York. Doctor Fink was formerly with the General Electric Co. and later in charge of the research laboratory of Guggenheim Brothers.

**Ernest V. Pannell,** who has been acting as consulting engineer and metallurgical expert for the British Aluminum Co., Ltd., in New York during the past two years, is now on his way to take care of the company's business in Tokyo, Japan.

**Frederick F. Sharpless,** secretary of the A. I. M. E., has been elected a corresponding member of the Canadian Institute of Mining and Metallurgy. The term "corresponding member" is used by the Council of the Canadian Institute to indicate complimentary membership.

**J. E. Elliott** and **F. C. Merritt,** consulting engineers and geologists, have an office at 205 South Broadway, Los Angeles. Last year, Mr. Elliott resigned his position as associate professor of petroleum mining at Stanford University, to undertake the special work of taking core samples from oil wells drilled by the rotary method.

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## Schuyler Lawrence

SCHUYLER LAWRENCE, long a resident of Chihuahua, Mex., where he was a prominent member of the Chihuahua Foreign Club and the first president of the American Society of the State of Chihuahua, died at Mysox, Pa., on Jan. 9, after a long illness.

Mr. Lawrence was born in Topeka, Kansas, in 1864, a son of Warren W. H. Lawrence, then Secretary of State for Kansas, and Sarah Schuyler, daughter of Judge Philip C. Schuyler, a noted Free State leader and president of the Free State convention of 1855. In addition to the Schuylers, Mr. Lawrence had among his ancestors the other well known New York families of Van Rensselaer, Van Cortlandt and Livingston.

At the age of eighteen, Mr. Lawrence went to Mexico with the late A. A. Robinson, in the mechanical engineering department in construction of the Mexican Central Railway from El Paso to Mexico City. After the road was completed, he turned his attention to mining and settled in the city of Chihuahua, his principal operations being on properties in the nearby old camp of Santa Eulalia. Chihuahua claimed him as a resident until soon after the beginning of the Mexican revolutions. At that time, he moved to Mysox, Pa.,

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where, to keep from rusting, he went into the raising of high-grade apples.

During the World War, Mr. Lawrence was in charge of the Intelligence Bureau of the Mexican Division of the War Trade Board, where his work was of such high character that he was prominently mentioned, at the beginning of the Harding Administration, for chief of the Mexican Division of the State Department—a post finally won by Fletcher, former Ambassador to Mexico.

He married, in 1910, Miss Mary Welles, of Towanda, Pa., and is survived by his mother, his wife and two sons, Schuyler, Jr. and Charles, and a brother, Cortlandt Lawrence of Los Angeles.

Mr. Lawrence was a member of the American Institute of Mining and Metallurgical Engineers and of the American Society of Mechanical Engineers.

## Charles Baskerville

CHARLES BASKERVILLE, director of the chemical laboratories of the College of the City of New York, died of pneumonia on Jan. 28, 1922. Born in Mississippi, June 18, 1870, he studied at the University of Mississippi in 1886 and 1887 and was graduated from the University of Virginia in 1890. He attended Vanderbilt University in 1891, and received the degree Ph. D from the University of Berlin in 1893 and from the University of North Carolina in 1894. From 1891 to 1904 he was connected with the chemistry staff of the University of North Carolina as instructor, assistant professor and professor of chemistry and director of the chemical laboratory. In 1904 he became professor of chemistry at the College of the City of New York.

Doctor Baskerville was a member and councillor of the American Chemical Society, a fellow of the American Association for the Advancement of Science, a fellow of the Chemical Society, London, a member of the Society of Chemical Industry, the American Electrochemical Society, the American Institute of Mining and Metallurgical Engineers, the New York Academy of Sciences, the Franklin Institute, Phi Beta Kappa Society and the Delta Kappa Epsilon Fraternity. His clubs were the Century, Engineers, Chemists' Graduate, City College, Colonado, Southern and Authors'.

An editorial in the New York *Times*, a few days after his death, pays tribute to his work as a scientist and forms a fitting obituary. The *Times* says:

The service, at once scientific and humanitarian, of Dr. Charles Baskerville is illustrative of what the science of chemistry is undertaking for the alleviation of human suffering. Doctor Baskerville's special researches had to do with the causes and prevention of occupational diseases and with the purifying of ether as an anesthetic.

Several centuries ago the chemist and the physician coöperated. Then they separated, the chemist turning toward industrial production. Now it is being realized that, though the bacteriologists and pathologists have accomplished wonders, they have "definitely reached a point where they must turn to the chemists for the solution of many of their most important problems." Not only are the chemists' medicaments needed for the cure or alleviation of certain specific diseases, but their advice is needed as to the acceleration or retardation of chemical reactions that take place in the body. The myriad battles with avoidable or preventable disease there go daily on. The lesson of the war intimates what victories may be expected in these battles from the coöperation, under ideal conditions of time and research, on the part of those whose science touches these very issues of life.

Doctor Baskerville, not only by his own researches, but also and especially by developing and equipping what was perhaps the best series of chemical laboratories in the United States and by organizing a department which has given tuition to hundreds of young men for service in this science, made his lasting contribution, though his studies and researches and teaching here are over. It will be remembered, however, that but a few weeks before his death, after years of intimate study of the atom, he said that "there is something that cannot be explained on a purely materialistic hypothesis." So the quest goes on.

## L. W. Stedman

LOUIS W. STEDMAN was born at Dixton, Ill., in 1861. He was graduated from the high school of that town, and entered Cornell in 1882. He did prospecting work at Fort Steele, B. C., and later went to the Coeur d'Alenes district, Idaho, where he was superintendent and manager for the Paragon Mining Co.

He died of pneumonia, on May 10, 1921, at Valleyford, Wash., and was buried by the Elks Lodge at Spokane. His wife and one son, Donald, survive him.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Jan. 14, 1922 to Feb. 18, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1920 | Baskerville, Charles | Jan. 28, 1922 |
| 1890 | Benson, A. J. | |
| 1917 | Campbell, Donald G. | Dec. 18, 1921 |
| 1920 | Hoyt, Donald C. | Dec. 27, 1921 |
| 1920 | Lannon, James A. | Jan. 21, 1922 |
| 1915 | Reed, Hubbard W. | Jan. 30, 1922 |
| 1910 | Selbie, Charles C. | March 1921 |
| 1917 | Stedman, L. W. | May 10, 1921 |
| 1917 | Vance, Stratton | Aug. 1921 |
| 1917 | Whitney, L. H. | Dec. 17, 1921 |

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# Institute Affairs

## Honorary Membership in Foreign Societies to A. I. M. E. Members

SIR John Cadman was the guest of the Board of Directors of the A. I. M. E. at the dinner preceding the meeting of the Board on Dec. 16, 1921. Sir John served with his government during the war as an expert on petroleum and it is in this connection that he is now visiting the United States. In addition to his technical engagement, he was commissioned by the Institute of Mining Engineers, of which he is president, and the Institution of Mining and Metallurgy, to present certificates of Honorary Membership to the president of the Institute and the members of the John Fritz Medal delegation to Europe in June, 1921.

A list of all the honorary degrees conferred was printed in a previous number of MINING AND METALLURGY in accordance with cable information. Owing to a slight inaccuracy in the cable, this list as printed did not represent the list of degrees as finally conferred. They were as follows:

| | |
|---|---|
| Iron and Steel Institute | Charles F. Rand |
| Institution of Mechanical Engrs. | Ambrose Swasey |
| Institution of Mining Engrs. | Ambrose Swasey |
| Institution of Mining Engrs. | William Kelly |
| Institution of Mining and Metallurgy | Arthur S. Dwight |
| Institution of Mining and Metallurgy | Edwin Ludlow |
| Society of Civil Engrs. of France | Ambrose Swasey |
| Society of Civil Engrs. of France | Herbert Hoover |
| Officer of Legion of Honor | Ambrose Swasey |

In conferring these certificates, Sir John made the following felicitous remarks:

### Edwin Ludlow

In you, Mr. Ludlow, we on the other side recognize a man of great ability, distinction and character. Your early pioneer and reconnaissance work in railway engineering is well known to us, and your activity and thoroughness which you have displayed in the development of coal mining, in which you have brought to play scientific methods, have marked you out as a man amongst men.

The positions of great responsibilities which you have held bear testimony to your greatness in the profession of mining engineering.

To you as president of the American Institute of Mining and Metallurgical Engineers, occupying the most dignified and highest office which your fellow engineers can bestow upon you, we desire to show our personal appreciation and admiration. At the same time we wish to convey through you to the great profession which you so ably adorn our good will and enduring friendship, and also to congratulate you on the occasion of the Institute's Jubilee.

We recognize the great and excellent work which your institution has already accomplished and is accomplishing, and we desire to raise our voices in praise of the unremitting energy, ability and learning which you are displaying in the interest of science in those vast fields of mining and metallurgical activities over which this institution plays such a powerful and important part.

As the distinguished president of the American Institution of Mining and Metallurgical Engineers, as a man of great attainments in the profession, I am privileged to present to you the diploma of Honorary Membership of the British Institution of Mining and Metallurgy.

### Colonel Arthur Smith Dwight

You were one of the delegation that visited Europe and carried the message that touched the hearts of British engineers. In you we recognize a man of great qualifications and great talents. We have long followed your distinguished career and we recognize in you an example of those sterling qualities of learning, activity and uprightness which is a characteristic of your great race.

As an engineer, inventor and scholar you have won a high place not only in your own country but amongst the engineers of the whole world, and as a soldier your activities rank second to none in your devotion to duty and gallantry in the cause of freedom and honor. You served as Major in the 11th Engineers, which with hardly any other weapon than the pick and shovel, thrilled the Allies by the noble and brilliant service at Cambrai on that memorable Nov. 30, 1917. For your great service in the war my country was pleased to confer on you the Distinguished Service Order. For your distinguished service in the science and art of mining engineering, I am deputed by the Institution of Mining and Metallurgy of Great Britain to hand to you the highest honor which it is our privilege to bestow—that of Honorary Membership in that body.

### William Kelly

Your work as a mining engineer is so well known and so varied that it would be impossible for me to touch upon the many phases of your activity in the pleasant task which has fallen to my lot to perform on behalf of the mining engineers of Great Britain. We recognize in you a mining engineer whose experience and ability places you amongst the highest in the profession.

We were honored in welcoming you in England as a delegate conveying the message which the American engineers were kind and generous enough to send to British engineers, and we appreciated to the full the warm and touching manner in which you personally played your part.

We desire to show our deep appreciation and cordial thanks to you and those who were associated with you in the kind thoughts which prompted that mission, and we wish to honor you as a man of attainments and ability in every way fitted to receive and to convey our lasting admiration to your great engineering profession. On behalf of the Institution of Mining Engineers of Great Britain, I have pleasure in presenting to you the diploma of the Institution of Mining Engineers.

### Another Feature of the Dinner

Another interesting feature of this last dinner of the outgoing administration was its tribute to the retiring and incoming presidents by W. L. Saunders who said:

As this is the last one of these delightful monthly dinners prior to the Annual Meeting of the Institute, it seems fitting, and to me it is a pleasure to say a word about him who is to go out of office as president of the Institute and him who is to come in.

I noticed your enthusiasm a moment ago when we drank to the health of Ludlow. It is also apparent that Ludlow has gained in popularity. Witness the large attendance at this dinner, requiring side tables to accommodate the crowd. This recalls to my mind an incident over in New Jersey when a Mayor was elected on the Democratic ticket. At the time of his going out of office they held a dinner and after the dinner a colored gentleman shook the hand of the Mayor and said: "Mr. Mayor, when

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you was elected some of us colored people voted for you, but now that you are going out we are all unanimous for you."

Some of us who are ex's—and I use the word ex somewhat in the light of extinguished—some of us extinguished presidents, while we may not have much power in the Institute just now, yet have had a lot of experience and through that experience we watch with a jealous eye the work of our successors. I have been watching Ludlow, and I confess that as president of this Institute he has been a past master in the activity of his mind and service, digging into the affairs of the Institute and planning its betterment. He has been totally absorbed by the work of the Institute. His very excellent wife told me the other day that it is the first time since their marriage that she has had occasion to be jealous of anybody or anything; that Ludlow has the Institute on his mind day and night,—so much so that she is becoming alarmed lest he forget that he is a married man. He has already forgotten all he knew about coal.

President Ludlow has brought into the activities of the Institute a practical mind, combining the engineer and business man, a sense of duty and a knowledge of economics that cannot fail to produce wholesome results. Long life to you, Mr. President! May you continue to prosper in ever increasing health, happiness and enjoyment!

As to him who is to come:

> Our hopes, our fears,
> Our love, our tears,
> Are all with you, are all with you.

He can well take care of himself for he is a Colonel. Colonels always take care of themselves, even in battle. When another distinguished Colonel, William Jennings etc., enlisted in the Spanish War his wife approached him in tears as he stood before her in uniform with the eagle on his shoulder and said: "I don't want you to go away. I am afraid you will be killed." The eminent William Jennings replied: "Did your ever hear of a Colonel being killed in battle?"

Well, we all hope that Colonel Dwight will survive the battles of the Institute. We all know that long before America entered the war he first, as a member of the Military Engineering Committee, sat in a board room and gave his time and effort to the cause of preparedness. It was Colonel Dwight, with others, who organized an Engineers' Regiment, equipped at private expense, and sent across the water to aid in the great cause of humanity. We all know how well they performed, and no one did more than Colonel Dwight, who was awarded the Distinguished Service Order.

We are proud to have such a president and we are happy in making the prediction that the Institute under him will continue to grow as one of the strong arms of the engineering profession.

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## American Engineering Standards Committee and its Work

THE American Engineering Standards Committee essays to serve as a national clearing house for engineering and industrial standardization, to act as the official channel of coöperation in international standardization, and to provide an information service on engineering and industrial standardization matters. The ultimate responsibility for and control of the work rests with the organizations whose representatives constitute the American Engineering Standards Committee. At present these include five departments of the Federal Government, nine national engineering societies, and fourteen national industrial associations.

The Committee functions as a clearing house rather than as a creator of standards.

At the time of the organization of the Committee, there were more than one hundred organizations publishing engineering standards, most of which were formulated without systematic methods of coöperation between the organizations concerned. At the present time 145 organizations are actively coöperating in the work of the Committee, having appointed accredited representatives to serve on section committees.

The function of the main Committee is merely to assure each body or group concerned in a standard an opportunity to participate in its formulation, which is in the hands of a so-called "sectional committee," made up of representatives designated by the various bodies interested.

Such bodies are known as "sponsors." This plan makes the Committee the most decentralized of all the national bodies.

### Method of Work

For some years, the unification and approval of existing standards will necessarily form an important part of the Committee's work. The most satisfactory way of determining the status a standard has in industry is to submit it to a duly organized sectional committee. Before acting on the approval of a standard submitted, a notice of its submission is sent to the technical press, and to the industrial associations and technical bodies interested, requesting information as to the standard in meeting the needs of industry, and the matter is referred to a special committee for investigation. This special committee often contains accredited representatives of those bodies most concerned with the standard, in order that the spirit of the sectional committee method may be carried out.

The A. E. S. C. is not an initiating body and work on a project is undertaken only upon a formal request from a responsible body, and then only after the Committee has assured itself that it is the desire of the industry that the work should go forward.

On account of the great diversity in the lines of standardization activities of the bodies coöperating in the A. E. S. C. work, the coördination of all of them by means of clearing house methods involves the handling of a large number of separate projects. If it is the desire of any industry to have a general committee representative of the industry as a whole, as a means of developing and correlating the standardization work of the industry, such a general correlating committee is set up.

The General Correlating Committee for Mining Standardization has completed its organization and has brought about the spirit of coöperation between the several bodies interested in standardization in the mining field, and developed the methods necessary for carrying out the coöperative work. The schedules of the Bureau of Mines on safety rules for electrical equipment in bituminous coal mines, storage batteries for use in gaseous mines and portable electric mine lamps are being reviewed by sectional committees, the first under the joint sponsorship of the Bureau of Mines and the American Mining Congress, and the last two under the sole sponsorship of the Bureau of Mines. The Correlating Committee has under con-

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sideration the general subject of the technical provisions of basic mining laws and regulations.

Of the total net income for 1921, approximately 70 per cent, or $17,208.33, was from the dues of the member bodies, $500 annually for each representative on the Committee, with the exception of the Government Departments, which have not yet been authorized by Congress to contribute their share of the expenses of the Committee. During the year financial support to the amount of $5575 was received from companies interested in standardization, as a result of appeals made by the Finance Committee, and $1850 through the efforts of Stanley G. Flagg, Jr.

The present income is not sufficient to provide adequately for the work now before the Committee. The work requested by the industries is increasing rapidly. It has doubled in the last year. A committee on ways and means has been appointed to formulate a comprehensive plan to meet the situation.

GEORGE C. STONE.

## United Engineering Society *

IN THE affairs of the Founder Societies, events of unusual interest occurred during 1921. Important renewals and improvements were made in Engineering Societies Building. Reductions in prices for some commodities conduced to slightly lower operating costs. By strict regard to economy in every detail, our income was made adequate to cover maintenance and operation and to provide for the required addition to the Depreciation and Renewal Fund, but not sufficient to allow payments into this fund to make up the deficiency of last year and other preceding years.

In April, Calvert Townley resigned as trustee representing the Electrical Engineers, vacating the office of first vice-president and the chairmanship of the Finance Committee. W. L. Saunders, second vice-president, was elected first vice-president and appointed chairman of the Finance Committee. Irving E. Moultrop was elected second vice-president.

Superintendent Osterberg lost his life as the result of an automobile accident in August, and Alexander S. Diven, formerly office manager for the Mechanical Engineers, was chosen to fill the vacancy, beginning Sept. 1.

### SEVENTY-FOUR THOUSAND ENGINEERS REPRESENTED

The membership of the four Founder Societies at the end of the year was 49,938, and of the Associate Societies 24,603, so that a total of 74,541 engineers have headquarters in our building. Other technical societies holding meetings in the building have a large aggregate membership in addition.

Upon application by United Engineering Society to the Carnegie Corporation for financial assistance on behalf of the Library, an appropriation of $10,000 a year for two years was made by the Corporation, for extraordinary library expenses, beginning July 1, 1921.

National Electric Light Association informed United Engineering Society that its National Executive Committee had voted an appropriation of $1000 to the Library in response to our request.

A special appropriation of $1250 each toward expenses of the Library for the past year was made by the Civil, Mining, and Mechanical Engineers.

### ENGINEERING FOUNDATION

The annual income of the Foundation is now at the rate of $25,000. The accumulated unexpended balance on Dec. 31, 1921 was $12,958.33. Close relations with National Research Council and contributions to the support of its Division of Engineering were continued. On Oct. 1, Alfred D. Flinn, secretary of the Foundation, was elected also chairman of the Division of Engineering of National Research Council.

Important research projects have been assisted, both directly and coöperatively with the Research Council. Among these may be mentioned: the National Advisory Board on Highway Research, Fatigue of Metals, Industrial Education and Training, Graphitic Corrosion of Cast Iron, Personnel Research Federation and Paint-on-Wood Research.

Work under the agreement of the Foundation with National Research Council and the University of Illinois, on the investigation of the fatigue phenomena of metals, has been completed and a full report printed as Bulletin 124 of the Engineering Experiment Station of the University of Illinois. A publication on this subject soon to be issued by the Foundation is being prepared.

### ENGINEERING COUNCIL AND JOHN FRITZ MEDAL BOARD OF AWARD

At the beginning of the year, the business of Engineering Council was turned over to the new American Engineering Council. It was voted to pay to J. Parke Channing the unexpended balance of funds remaining in the treasury of United Engineering Society to the credit of Engineering Council, at the final closing of the Council accounts, in full settlement for funds advanced under his guarantee for certain expenses. Two of the Founder Societies, the Civil and the Mechanical Engineers, through United Engineering Society, reimbursed Mr. Channing for their pro rata share of the money that he advanced for Engineering Council.

The John Fritz Medal Board of Award, composed of representatives of the Founder Societies, awarded the medal for 1921 to Sir Robert A. Hadfield "for the invention of manganese steel," and for 1922 to M.

* Excerpts from report for the year 1921 by J. VIPOND DAVIES, President.

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Charles Prosper Eugène Schneider "for achievement in metallurgy of iron and steel; for development of modern ordnance, and for notable patriotic contribution to the winning of the Great War."

### Visit of Marshal Foch

Ferdinand Foch, Marshal of France, and after March 25, 1918, Generalissimo of the Allied Armies in the World War, in America as the guest of the American Legion., visited Engineering Societies Building to receive a certificate of honorary membership in the four Founder Societies.

### Alfred Noble Memorial

The American Institute of Consulting Engineers presented to United Engineering Society a bronze tablet commemorating the achievements of Alfred Noble.

### Resolutions Presented to Doctor Durand

Dr. W. F. Durand was present as guest of honor at the November meeting to afford opportunity for the Founder Societies and the Society of Naval Architects and Marine Engineers to present resolutions expressing appreciation of his services as chairman of the Committee on Management, of the International Engineering Congress of 1915, in connection with the Panama Pacific International Exposition at San Francisco.

### Finances

| | |
|---|---|
| The income of U. E. S. for 1921 was | $117,009.93 |
| The expenses were | 101,370.21 |
| Balance for the year | 15,639.72 |
| This balance includes $6,724.73 in accounts receivable, and $125 uncollectable accounts written off Dec. 31, 1921. | |
| *Funds held by U. E. S. Dec.* 31, 1921 (Book Values) | |
| Engineering Foundation | $502,066.05 |
| Library Endowment | 93,351.25 |
| General Reserve | 10,000.00 |
| Depreciation and Renewal | 98,639.47 |
| Total | 704,056.77 |
| The real estate owned by U. E. S. cost to Jan. 1, 1921 | $1,957,354.31 |
| Permanent addition to building during year | 1,786.36 |
| Cost to Dec. 31, 1921 (cannot be reproduced for that sum) | $1,959,140.67 |
| Total net assets | $2,689,834.75 |

### Changes in Board Membership

In April, the resignation of Calvert Townley, trustee representing the American Institute of Electrical Engineers, was presented and accepted with regret. Henry A. Lardner was appointed his successor.

The new members joining the Board of Trustees during the year were: Arthur P. Davis, representing A. S. C. E.; Edwin Ludlow, representing A. I. M. E.; Worcester R. Warner representing A. S. M. E.; H. H. Barnes, Jr. representing A. I. E. E.

The members retiring by rotation at the end of this year are: J. Vipond Davies, representing A. S.C. E.; W. L. Saunders, representing A. I. M. E.; Irving E. Moultrop, representing A. S. M. E.; Bancroft Gherardi, representing A. I. E. E.

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## Plan and Scope of Engineering Societies Library

THE Engineering Societies Library was founded in 1913 to meet the need for an engineering library equipped to aid efficiently in engineering research and professional practice. In spite of the rapid growth of libraries in America during recent years, no such institution existed. The university and college libraries, while often rich in material, lacked facilities for making it available. The public libraries usually could not maintain engineering collections of satisfactory scope nor employ custodians with special training in engineering.

Consideration of the needs of the engineer led to the conclusion that these could be best and most economically satisfied by the establishment of a library for the profession, directed by engineers, and administered with their special needs in view. Broadly speaking, the conception was of a complete collection of engineering literature, so arranged, catalogued and indexed that whatever had been printed on any matter could be found with the minimum effort and least loss of time. With this ideal as the goal, the Engineering Societies Library was founded.

As the Engineering Societies Library was organized through the coöperation of the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, the union of their individual libraries gave at once a collection of great practical value, covering not only mining, machinery and electricity, but many allied subjects as well. In 1916 the American Society of Civil Engineers became a fourth Founder Society, and its library, the oldest engineering library in the country, added much important material to the collection.

It was realized that many engineers have no opportunity to visit the library and carry on personal searches for information, and that if these engineers are to be benefited some arrangement must be provided by which its resources can be available at a distance; and the necessity of providing suitable means for doing this has been kept in mind.

The program toward which the Library Board looks has a vast scope; summarized, these plans include:

1. A book collection covering engineering and the allied sciences, as complete as possible.

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2. Catalogs, indexes and bibliographies making the information in these books accessible at once.

3. A staff of skilled searchers and translators, available for special investigations.

4. Devices for copying documents.

5. A lending library.

6. Published guides to engineering literature, abstracts, bibliographies, etc.

Work has been in progress along the first four of these lines since the beginning.

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## Meetings of Directors

A REGULAR meeting of the Board of Directors was held at Institute headquarters on Dec. 16, 1922. Before the meeting began, Sir John Cadman presented certificates of honorary membership to Messrs. Ludlow, Dwight and Kelly (see page 63).

Ferdinand Foch was elected to honorary membership by a unanimous vote of all Directors present. The report of the Committee on Membership containing the names of 98 candidates for membership in various classes was approved.

Colonel Arthur S. Dwight presented a letter announcing that Columbia University extended to the Directors of the Institute the privilege of naming a recipient of a scholarship in mining or metallurgy in the School of Mines, Engineering and Chemistry beginning with the year 1922–23. This scholarship pays $350, about the amount of the annual tuition fees. The offer of Columbia University was accepted and referred to the Committee on Scholarships, which was instructed to coöperate with the Woman's Auxiliary in seeking a suitable candidate for appointment.

The Princeton Engineering Society and the Crucible Club of the University of Nevada were recognized as Affiliated Student Societies.

George C. Stone submitted a report on the work of the American Engineering Standards Committee, with which the Institute coöperates.

Amendments to the By-Laws, published in the January number of MINING AND METALLURGY, were adopted.

After completion of formal routine business, the meeting adjourned.

At the meeting of the Board held on Jan. 27, the Treasurer and Finance Committee submitted a report for the year 1921 showing an available balance to be carried forward of $37,934.78 which will be chiefly used in publishing the papers presented in 1921.

The Finance Committee submitted a budget showing estimated receipts for the year 1922 of $204,534.78 and estimated expenditures of $203,875.00. This budget was referred to the new Board of Directors with the recommendation that it be adopted.

The names of Henry S. Munroe and R. J. Frecheville were placed upon the Honor Roll of Senior Members by unanimous vote.

The New York Section presented a resolution respecting the licensing of engineers in New York State, which was favorably acted upon by the Board. This resolution was published in the February issue of MINING AND METALLURGY.

Following the approval of the resolutions of the New York Section, a resolution respecting the licensing of mining engineers throughout the United States was offered by President Ludlow. This resolution was adopted in the following form:

WHEREAS the Licensing and Registration Laws have been already enacted in twenty of the States and are being proposed for enactment in a number of other States;

AND WHEREAS the results of the operation of these laws in the States where they are now in force have proved that they are not advantageous to the profession of Mining Engineering, but that, on the contrary, the restrictions requiring separate licenses in each State are unnecessary and burdensome to a profession the members of which are likely to be called upon to practice in many different States in the course of a year;

AND WHEREAS it has been further shown that licensing of Mining Engineers brings an added danger to the public in the States where licensing laws have already been passed, as persons calling themselves mining engineers, but without the proper experience and judgment, have been able to pass the rather superficial examinations and obtain licenses and have been employed by unscrupulous promoters, who advertise the fact in their prospectuses that the property they are placing before the public has been approved by a licensed engineer.

THEREFORE BE IT RESOLVED that the Board of Directors of the American Institute of Mining and Metallurgical Engineers hereby protests that Mining Engineers should not be included in the list of engineers who are required to obtain State Licenses;

AND BE IT FURTHER RESOLVED that in States where Licensing Bills are now being introduced, a committee of our members residing in that State shall be asked to appear before the proper Legislative Committee to urge that Mining Engineers be omitted from the provisions of any proposed legislation;

AND BE IT FURTHER RESOLVED that in States where licensing laws are now in effect, Local Sections of the Institute residing in that State be requested to petition their Legislatures to amend the licensing law in force so as to omit from its provisions the Mining Engineers.

IT IS FURTHER RESOLVED that this resolution shall be published in MINING AND METALLURGY for the information of our members, and that copies of this resolution be mailed to the Chairman and Secretaries of our Local Sections.

The reports of our representatives on American Engineering Council and that of the Joint Committee on Code of Ethics were received. The latter is published in this issue. (See page 46.)

Representatives were appointed to attend a conference in Philadelphia respecting the holding of an Engineering Congress in that city in 1926.

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## Institute of Metals Division Summer Meeting

PAPERS to be presented at the summer meeting of the Institute of Metals Division must be sent to the office of the Secretary of the A. I. M. E. not later than March 24. The meeting of the Institute of Metals Division will be held in Rochester, June 5–9, in connection with the meeting of the American Foundrymen's Association.

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# Activities of Other Societies

## A. S. C. E. 69th Annual Meeting

THE American Society of Civil Engineers held a most successful meeting in New York on Jan. 19–20. National Transportation Problems, subdivided into Water Transportation, Railroad Transportation, etc., furnished the topics for the sessions in the Engineering Societies Building. Excursions were made to the McGraw-Hill Publishing Co., the Stock Exchange, and several other points of interest, and there were many social gatherings.

Honorary membership was conferred on Eugène Schneider, Luigi Luiggi, Samuel Rea, Ambrose Swasey and Howard A. Carson.

## Electrochemical Spring Meeting

ONE of the papers to be presented at the meeting of the American Electrochemical Society, Apr. 27–29 in Baltimore, Md., is by Dr. Duncan MacRae of the Westinghouse Research Laboratory, and describes a new method for determining the pressure in a tungsten vacuum lamp. The principle is simple and more accurate than the approximation that has heretofore been made by the use of the induction coil. The pressures are measured by a McLeod gage. The measurements on lamps immediately after the process of exhaust (before "flashing"), and after "flashing," as well as on life tested lamps, are given. The operation known as "flashing" consists in lighting the lamp during exhaust in the presence of phosphorus or other chemical substance.

The Society is planning three sessions, on Electric Furnace Cast Iron, Gases of the Electrochemical Industries, and Electromotive Chemistry.

## Taylor Society Meeting

THE tentative program for the meeting of the Taylor Society to be held in Philadelphia, March 16–18, includes papers on:

A Case of Sales Research, by John M. Holcombe, Jr., Manager Sales Research Division, Phoenix Mutual Life Insurance Co., Hartford, Conn.; Problems of General Management, by Henry P. Kendall, of Boston; Super-standards, by Frank B. and L. M. Gilbreth; Budget Control, by George E. Frazer, of Chicago; Mills, Minds and Men, by Arthur Pound, author of the articles, "The Iron Man," now appearing in the *Atlantic Monthly;* String-Board Graphics, by Percy S. Brown, works manager, Corona Typewriter Company; Work of the Balance of Materials Clerk, by Thomas W. Mitchell, of Philadelphia.

## A. A. A. S. June Meeting

THE American Association for Advancement of Science will hold a meeting in Salt Lake City, from June 22 to 24, conjointly with the Pacific Division of the Association. Arrangements will be mainly in the hand of the Pacific Division, the secretary of which is W. W. Sargeant, Golden Gate Park, San Francisco, Calif. The permanent secretary's office in Washington will assist. All members of associated societies are invited to attend.

## American Welding Society Proceedings

THE American Welding Society, which was established in 1919, has begun to issue Proceedings, the first number bearing the date of January, 1922. The American Welding Society is organized to provide united and coöperative action in extending the knowledge of the art of welding and its field of industrial application. The field for further application of welding is enormous, and progress in it is being delayed only by incomplete knowledge and by the confusing and opposing claims of competing interests.

The Society acts as a clearing house for information. Through papers and monthly meetings of local sections, an opportunity is created for the individual manufacturer, engineer, plant superintendent, foreman or operator to contribute his own knowledge in welding and at the same time receive the benefit of the combined knowledge and experience of all other members of the Society. Special publications in addition to the regular monthly Proceedings are issued from time to time, giving results of researches, standardization work and other information of value to the members. The offices of the society are at 33 West 39th St., New York City.

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# Local Sections and Affiliations

## New Officers of New York Section

ABOUT ninety members and guests attended the annual meeting of the New York Section, on Feb. 8. The following officers were elected: chairman, Robert Linton; vice-chairmen, Robert M. Raymond and Donald M. Liddell; secretary-treasurer, E. L. Gruver; committeemen, B. Britton Gottsberger and Bradley Stoughton.

## Electrothermic Metallurgy of Zinc

AN illustrated talk on the electrothermic metallurgy of zinc was given before the Ohio Section by Prof. C. H. Fulton, director of the Missouri School of Mines, at its meeting on Jan. 20. Sixty members were present. Before the talk the question of meeting with the Cleveland Engineering Society was discussed.

## St. Louis Section Entertained by Mr. Thacher

THE St. Louis Section held a very enjoyable meeting on Thursday evening, Feb. 9, at the home of Arthur Thacher. About fifty members and guests were entertained.

The chief topic of the evening was Collective Bargaining: Does It Best Serve the Interest of the Public, the Investor, the Employee? The speakers were W. K. Kavanaugh, Eugene McAuliffe, Philip N. Moore, and Arthur Thacher. The meeting was informal and there was interested general discussion.

## Aluminum and Its Alloys

IN HIS talk at the January meeting of the Boston Section, R. H. Pomeroy, of Cleveland, vice-president of the Institute of Automobile Engineers, discussed the suitability of aluminum for general engineering constructions, from the point of view of its low specific gravity and its capacity to sustain loads by virtue of extended dimensions; its suitability for replacing malleable-iron and steel castings; the use of forged aluminum for highly stressed parts; the economic aspects of its use because of its capacity for being rapidly machined.

Just before this talk, Robert J. Anderson, metallurgist of the Bureau of Mines, gave an illustrated talk in which he described the discovery and history of aluminum its development and present application, and the peculiar properties of its alloys.

## Kingman Section Second in Arizona

KINGMAN has the distinction of having the second chapter of the American Institute of Mining and Metallurgical Engineers in Arizona. The section was organized at a meeting of representative mining engineers of Mohave County on Feb. 9. Officers were elected as follows: Roy Moore, of Oatman, chairman; R. S. Billings, of Kingman, vice chairman, and secretary-treasurer; these officers, with W. B. Phelps, of Oatman, S. Ford Eaton, of Chloride, and R. C. Jacobson, of Kingman, compose the governing board.

There are more than 50 engineers in Mohave county eligible to membership in the local chapter. The committee on membership is planning a campaign which will be submitted to the local chapter for sanction at its next meeting.

One of the first official acts was to pass a resolution inviting Herbert Hoover, Secretary of Commerce, to visit Kingman as a guest of the section during his contemplated trip to dam sites along the Colorado river.

## Zinc and Copper Discussed by Colorado Section

AT THE annual meeting of the Colorado Section, on Feb. 4, Robert Hursh read an interesting paper on the "Application of Zinc to Modern Industry," in which he urged all present to do all they could to increase the use of metals. He exhibited a number of articles made from zinc and brass, also a copper shingle made by the Anaconda Copper Mining Co. Afterwards, the secretary read a paper, "Copper a Metal of Commerce," that had been sent by the Anaconda Copper Mining Co.

This meeting was preceded by a dinner at which 65 members and guests were present. After the dinner the following were elected as officers for the ensuing year: Robert Hursh, chairman; J. C. Roberts, vice-chairman; Horace F. Lunt, secretary-treasurer; Max W. Ball and Charles N. Bell, additional members of executive committee. Mr. Hursh was appointed delegate to Colorado Engineering Council.

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## Underground Workings of Star Mine Studied by Columbia Section

AT THE February meeting of Columbia Section, F. W. Callaway, engineer for the Bunker Hill and Hecla mines, exhibited a model of the Star mine and explained the underground workings. W. G. Woolf then explained the process of zinc and lead metallurgy, illustrating his talk with samples of the crude ore, intermediate, and final products of the Star mine.

A committee was appointed to formulate a report on the present status and possibilities of economic production of petroleum in the vicinity.

The executive committee of the section consists of Rush J. White, chairman; F. M. Smith, vice-chairman, Ivan de Lashmutt, past chairman; L. K. Armstrong, secretary-treasurer; Francis A. Thomson.

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## Tulsa Section Protests Interior Department Ruling

CONSIDERABLE interest has been created recently in regard to the policy of the Osage Council in matters pertaining to the methods used in the sale of oil and gas leases and method of determining the value of leases offered for sale by the Osage Council in Osage County, Oklahoma.

At the last sale held under the supervision of the Department of the Interior, bids were rejected the day following the sale. Upon the advice of a geologist detailed by the U. S. Geological Survey to advise the Osage Council, the Tulsa Geological Society has passed resolutions protesting this action and has forwarded copies to Washington to the Secretary of the Interior, the Director of the Geological Survey, and to the Chief of the Osage Indian Council.

The Tulsa Section of the American Institute of Mining and Metallurgical Engineers prepared the following resolution along similar lines;

WHEREAS, During the past decade the science of geology has maintained a steady effort to win the confidence of the petroleum industry and has finally, through the force of results obtained, come to be looked upon as an integral and increasingly valuable part of that industry, and

WHEREAS, The faith of the industry in geological service is clearly demonstrated by the large sums of money being spent by the operators in securing expert geological advice and by the increasing numbers of individuals and companies who are shaping their policies to conform to the guidance of their geologists and engineers, and,

WHEREAS, The work of the geologist and engineer has been an important factor in the wonderful development of the Osage Nation, Oklahoma, and has had a marked influence upon prices paid at public auction for leases therein, and,

WHEREAS, The Osage Council has refused to accept bone fide bids made openly at public auction for Osage tracts, the said bids being made by reputable and established operators acting generally upon the advice of their geologists and engineers, and the impression prevails that these rejections were made at the advice of a representative of the United States Geological Survey, and,

WHEREAS, The said rejection of bids has placed the geologists and engineers in the employ of petroleum operators in the position of being in controversy with the official geologists of the United States Government, in regard to the valuation of oil and gas lands, and

WHEREAS, This situation has caused much adverse comment, and has been the basis of much criticism, of the United States Geological Survey and the Osage Council, for having rejected the highest bid.

BE IT THEREFORE RESOLVED, That the Tulsa Section of the American Institute of Mining and Metallurgical Engineers expresses its entire disapproval of the principle of review by the Osage Council upon geological advice of bids made at public auction of Indian land unless there is announced previous to the sale a minimum price which will positively be accepted, or it is made known at the time of announcement of the apparently closing bid on any one tract that the bid is below the minimum value and that the tract may be withdrawn.

RESOLVED, That copy of the resolution be forwarded to the Secretary of the Department of the Interior, to the Chief of the Osage Council, and to the Director of the United States Geological Survey.

This was signed for the Tulsa Section of the American Institute of Mining and Metallurgical Engineers, by Charles T. Kirk, J. R. Pemberton, and William J. Millard.

It was approved of and signed by the Executive Committee of the Tulsa Section, composed of M. M. Valerius, Jon A. Udden, Charles T. Kirk, L. L. Hutchinson, Alf. G. Heggem.

The annual meeting of the Tulsa Section was held on Jan. 27, 1922. Officers and members of executive committee were elected for the current year, as follows: chairman, H. B. Goodrich, Tulsa, Okla.; vice-chairmen, J. A. Udden, Austin, Tex.; Wallace E. Pratt, Houston, Tex., Sidney Powers, Tulsa, Okla.; secretary-treasurer, R. S. McFarland, Tulsa, Okla.; executive committee, Alf. G. Heggem, Tulsa, Okla.; W. R. Hamilton, Tulsa, Okla., Alexander Deussen, Houston, Tex., Charles H. Taylor, Oklahoma City, Okla.

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## Silver Discussed by Southern California Section

THE Southern California Section held a meeting on Jan. 13, with 65 members present. Walter Schmidt, acting chairman, presided. Before taking up the technical program of the evening, a short business session was held, the matter of principal interest being the report on the Bureau of Mines Bill by a committee composed of Messrs. Horace V. Winchell, chairman, Ralph Arnold and Nelson Nevius. This committee was appointed to consider and report on the proposed new Federal Mining Law as introduced by the Honorable Samuel S. Arentz (H R 7736). The reading of this report was followed by a general discussion by the members, and by resolution of the section, the majority report was approved.

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The committee took up particularly the three fundamental changes proposed in the mining law as follows: First, to abolish the existing Apex Law and substitute therefor vertical bounding planes. This principle had the unanimous, earnest endorsement of the committee. Second, the new law would eliminate the proposed requirements of a mineral discovery as a pre-requisite to location. This principle, also, had the unanimous earnest endorsement of the committee. Third, that section of the law requiring the location of square claims of 40 acres each laid out on cardinal lines was advocated by two members of the committee and opposed by the third.

There being no further business, Horace V. Winchell was introduced by the chairman as the first speaker of the evening, his subject being "Silver, the Genesis and Occurrence of its Ores and Various Types of Silver Deposits." Mr. Winchell opened his remarks with a brief history of the Pittman Act and then described various types of silver deposits which had come under his observation. Rush T. Sill followed with some very interesting notes on silver and its ores.

## Oregon Section Favors Revision of Mining Laws

AT ITS annual meeting, held at Corvallis, Jan. 21, the Oregon Section discussed the report of the committee that had been appointed by the Section to consider H. R. 7736 Bill to Revise the Mining Code of the United States of America. W. B. Dennis, chairman of the committee, Mr. Newton and Mr. Swartley made addresses on the principal features of the bill. The following resolution presented by W. H. Woodward was carried as amended:

The Oregon Section of the A. I. M. E. is in favor of revising and codifying the present mining laws of the United States and is in accord with the principles of H.R. 7736 and the abolishment of the apex law and extralateral rights, but we wish to call attention to the following objections (Summarized here):

Provision should be made for acquiring mineral rights on withdrawals of public land under necessary regulations.

The location and holding of mining claims on which no discovery has been made should not be authorized on the same terms with claims having a discovery.

Verification of discovery should not be entrusted to deputy mineral surveyors or other officers except under restrictions.

The provision that one discovery shall be sufficient for 160 acres unduly restricts opportunities.

The provision requiring patent within seven years will work hardship on the poor prospector.

The form of location notice should be uniform in all states.

Provision should be made for easement for right of way for tunnels to reach mineral deposits or for drainage purposes from without the claims.

Provision should be made for recording proof of labor and this record should be compulsory.

The Section believes that the provision for claims to be located by legal subdivisions or on cardinal lines is inadvisable.

Previous to the discussion of the mining code, H. M. Parks was reëlected chairman, and P. R. Hines was elected secretary-treasurer.

The Section will hold an informal luncheon meeting at the Chamber of Commerce on the first Thursday of each month.

## New Local Section Formed at Charleston, West Virginia

THE Charleston Section of the American Institute of Mining and Metallurgical Engineers, to take in the mining region of southern West Virginia and northeastern Kentucky, was formally organized on Feb. 14. The following account of the opening sessions is taken in part from the *Charleston Daily Mail* and in part from a letter from one of the members.

J. K. Anderson was elected president, W. J. Priestley, vice president, and C. E. Krebs, secretary-treasurer. The officers were elected at the close of the afternoon meeting, at which several interesting technical papers were presented. E. F. Ketter, engineer of the U. S. Coal & Coke Co., spoke on Dry Cleaning Coal Mills; W. J. Priestley, superintendent of steel making at the U. S. Armor Plant, gave a paper on Latest Achievements in the Manufacture of Steel.

On the evening of Feb. 14, a banquet was held. Carl Scholz officiated as toastmaster and there were talks by Edwin Ludlow, president of the Institute; Arthur Thacher, of St. Louis; J. G. Bradley, of Dundon, W. Va., president of the national coal association; Phil M. Conley, in charge of the department of Americanization and thrift for school children, state department of education, Charleston, and others. The entertainment following the banquet was concluded with an exhibition of motion pictures of industrial activities in West Virginia, especially around Charleston.

President Ludlow said that he believes that the salvation of the mining industry rests on standardization of production and better preparation as the remedy for the customary overproduction. He advocated five-year contracts between producers and consumers as the best way of avoiding strikes and contentions with labor.

The address of Mr. Bradley was devoted more particularly to the problems of producing and marketing bituminous coal. He advocated greater efficiency in operation of mines and employment of labor.

Mr. Thacher's talk began with reminiscences, praise of progress made toward higher civilization and predictions of greater achievement to come, but toward the close of his address he gave his hearers the benefit of a fund of information gained from his long practical experience as an engineer in both coal and metals mining. He advocated closer human relations between employer and employee, an honest day's work for an

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honest day's pay, and said that it had been his observation that a cheap wage means cheap work. He believes unionism for labor is founded on a wrong principle, will prove a failure and will be superseded by something better. "Not even a Sunday school picnic can be run with everybody taking a hand in the managing," he said, "it takes committees and representatives to get results."

Mr. Sumner, of the West Virginia Y. M. C. A., gave an account of the work his association is doing in the state.

On Feb. 15, the party visited the Owens Bottle Works at Kanawha City and witnessed the manufacture of bottles, an industry that is interesting to mining engineers because all the materials come from the mines in the vicinity. In the afternoon, the party visited the Naval Ordnance plant at South Charleston, under the guidance of Mr. Priestley.

## Affiliated Student Societies

**University of Oklahoma.**—The Pick and Hammer Club has an average attendance of 75 at its meetings. The officers are Earnest Word, president; Paul C. Teas, vice-president; Bess U. Mills, secretary-treasurer.

**Iowa State College.**—The Student Branch of the A. I. M. E. has officers as follows: Edward Thayer, president; Robert L. Wright, vice-president; Claude G. Grimm, secretary. The work of the society is being carried on with much enthusiasm and the meetings are well attended.

**University of Wisconsin.**—The Mining Club holds a meeting once a month, at which dinner is served and addresses are made on subjects of interest to the mining fraternity. The officers are W. F. Uhlig, president; A. M. Hill, vice-president; N. H. McKay, secretary-treasurer; M. M. Gorrow, mucker; D. M. Matheson, assistant mucker; E. W. Jones, publicity.

**Sheffield Scientific School, Yale University.**—The Mining Society has changed its name to Mining and Metallurgical Society. When the society was reorganized in January, the following officers were elected: chairman, W. K. Ziegfeld, Jr.; vice-chairman, F. W. Gledhill; secretary, H. D. Ruhm, Jr.; treasurer, W. R. Weaver.

**Lawrence College.**—The Geological Engineers Club recently arranged a meeting at which films on oil development were shown before a large community audience. The officers for the first semester of this year were Lloyd Wright, president; John Ockerman, secretary-treasurer. For the second semester, the president is Carroll A. Phillips, the vice-president is Carroll R. Rushton, and the secretary- treasurer is Homer M. Hunt.

**Case School of Applied Science.**—Every student taking the mining or metallurgical course, by tradition, must be initiated into the Pick and Shovel Club at the beginning of his sophomore year. Whenever possible, the members of the club attend the meetings of the Ohio Section and of the Steel Treaters Society. The officers are as follows: president, H. F. Roberts; vice-president, F. A. Lewis; secretary, I. E. Seith; treasurer, C. H. Hale; sergeant at arms, C. R. Brown.

## Woman's Auxiliary

THE regular monthly meeting of the General Council of the W. A. A. I. M. E. was held at the Engineering Societies Building, New York, Thursday, Feb. 2. Nine members were present, with Mrs. Philip Wiseman, of Los Angeles, as guest.

The Northern California section held a meeting on Jan. 27, at the Engineer's Club in San Francisco. The officers of this section are Mrs. Edmund Jüssen, chairman, Mrs. W. G. Morley, treasurer, and Mrs. Oliver C. Ralston, secretary.

This group of women is interested in finding a candidate for the Columbia University scholarship and for this purpose has enlisted the services of Dean Probert, of the University of California, and of Theodore Hoover, of Leland Stanford University.

The meetings of this section will be held on the fourth Wednesday of each month. Mrs. Sidney J. Jennings is acting proxy.

Mrs. Philip Wiseman, chairman of the Southern California section, read a letter from Mrs. W. F. Staunton, treasurer of that section, reporting its financial condition and expressing local views as to the best methods for the collecting of dues. On Jan. 3rd, this section held a luncheon at the Ambassador Hotel in Los Angeles, with 31 members present, during which Mrs. H. V. Winchell gave an interesting and thrilling talk on her experiences in Russia.

The Denver section reported having cast a unanimous vote for the revised constitution. This section is also in search of a candidate for the Columbia scholarship.

The Butte section also reported approval of the revised constitution and by-laws.

At its meeting on Jan. 17, the Utah section discussed the new constitution and by-laws. It did not express its approval of Article 8, Section 4, referring to the collection of dues. Mrs. Prosser was named proxy for this section for the ensuing year. Utah is also looking for a suitable candidate for the Columbia scholarship. There are 18 or 20 members at each of the monthly meetings. They collect and donate funds to various local charities.

The monthly luncheon of the New York Section was held at the Wiley's on Wednesday, Jan. 25, 1922. There were 68 present. Mrs. Mayer read a report in regard to the finding of quarters for the proposed club house and also presented an estimate of the cost of maintenance.

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Mrs. Taylor read a report from Mrs. Mulliken of the Washington section in regard to sending books and presents to mining camps, then introduced the speaker of the day, Miss Elizabeth Leighton Lee of the School of Horticulture for Women at Ambler, Pa. Miss Lee explained the scope of the School of Horticulture and told of the opportunities offered to women in this field. She feels that gardening and the care of animals are most appropriate vocations for women because of their maternal instinct and their instinct for cleanliness. Questions from the members followed Miss Lee's talk.

Mrs. Jennings, chairman of the Educational Fund Committee, advises that she has received very satisfactory reports from the University of California respecting the work of James Christie, who is the recipient of the Woman's Auxiliary scholarship for the present year.

Mrs. Hardinge reported that she had received a generous donation of books from Mrs. Harold Banks to be sent to Payson, Arizona.

The secretary was instructed to write to the chairman of the Anaconda and Butte sections, expressing to them the delight of the General Council upon learning of the reopening of the mines and mills of those districts.

In closing, a rising vote of thanks was given Mrs. Dwight for her untiring energy in working for the good of the Auxiliary for the past two years and for her unfailing courtesy under all circumstances.

# Increase of Membership Department

**Total membership as of Feb. 11, 1922, is 10,243**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period Jan. 20 to Feb. 18, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—Laurence W. Bevan,** Kingston, Pa.
Present position—1917 to date: Assistant General Manager, Hazard Mfg. Co., Wilkes-Barre, Pa.
Proposers: H. H. Ashler, R. V. Norris, E. S. Moore.

**2—William Whipple Copp,** Taft, Cal.
Present position: Petroleum Engineer, State Mining Bureau.
Proposers: S. K. Dahl, M. A. Newman, Robert B. Moran.

**3—Albert J. Fleming,** Scranton, Pa.
Present position—1915 to date: Vice President, J. R. Fleming and Sons, Mine Car Equipment.
Proposers: E. H. Leaning, R. H. Buchanan, Eli T. Conner.

**4—Kumao Fuwa,** Taganagun, Fukuokaken, Japan.
Present position—1905 to date: Chief Engineer and Superintendent, Tagawa Colliery.
Proposers: Takuma Dan, Tamaki Makita, Jokichi Fujioka.

**5—Harry Samuel Gay,** Mount Gay, W. Va.
Present position—1913 to date: General Superintendent of Mines, The Gay Coal and Coke Co.
Proposers: Howard Eckfeldt, Howard N. Eavenson, H. S. Drinker.

**6—Lewis Sniger Gillette,** Natchez, Miss.
Present position—1920 to date: President, Plymouth Investment Co., President, L. S. Gillette Co., Vice-President, U. S. Chamber of Commerce and Chairman of its building.
Proposers: Herbert Hoover, John E. Hodge, Horace V. Winchell.

**7—George Perry Henderson,** Mayer, Ariz.
Present position—1920 to date: Surveyor, Assayer and Office Chief, Swastika Silver and Copper Co.
Proposers: Frank W. Giroux, John C. Greenway, W. V. DeCamp.

**8—James Thomas Higgins,** Paint Cliff, Ky.
Present position—1921 to date: Superintendent, Paint Cliff Mines Co.
Proposers: Ivor Livingston, Walter B. Miller, W. H. Noel.

**9—Jess Charles Johnson,** Seattle, Wash.
Present position—1920 to date: Consulting Mining Engineer.
Proposers: Paul Billingsley, Harry Townsend, Milnor Roberts.

**10—Kinji Kawai,** Sorachi, Hokkaido, Japan.
Present position: Mechanical Engineer, Sunagawa Colliery, Mitsui Min. Co.
Proposers: Takuma Dan, Tamaki Makita, Kojiro Nishimura.

**11—Saburo Kawashima,** Sunagawa, Sorachigun, Hokkaido, Japan.
Present position—1920 to date: Manager of Mitsui Sunagawa Colliery.
Proposers: Takuma Dan, Tamaki Makita, Kojiro Nishimura.

**12—Edwin Williams Klumple,** New York, N. Y.
Present position—1921 to date: Vice President, Merring, Hicks and Co., Williamson, W. Va.
Proposers: Alan R. Blackburn, Samuel Melitzer, R. M. Peterson.

**13—Thomas Cooper Linderfelt,** Bartlesville, Okla.
Present position—1921 to date: Chief Geologist, Rood Oil Corpn.
Proposers: H. T. Beckwith, Alexander W. McCoy, A. L. Beekly.

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**14—Henry William Lohman,** Bellerose, L. I., N. Y.
Present position—1918 to date: Vice President and Treasurer, United Zinc Smelting Corp., New York, N. Y.
Proposers: Edwin O. Holter, B. B. Gottsberger, R. T. Cornell.

**15—Edward William Macleod-Elliott,** Likasi, Union Miniere, Katanga, Congo Belge.
Present position—1920 to date: Mine Captain and Acting Assistant Manager.
Proposers: A. E. Wheeler, F. W. Snow, Thomas S. Carnahan.

**16—Charles Williams Maxwell,** Marigold, Cal.
Present position—1916 to date: Amalgamator, Surveyor, Assistant to Manager, Marysville Dredging Co.
Proposers: Roy H. Elliott, Gerald H. Hutton, Edwin Higgins.

**17—Nagao Nomura,** Sunagawamura, Sorachi, Hokkaido, Japan.
Present position—1920 to date: Mining Engineer at Mitsui Sunagawa Colliery.
Proposers: Takuma Dan, Tamaki Makita, Jokichi Fujioka.

**18—Kiyoshi Oda,** Ohmuta, Chikugo, Japan.
Present position—1921 to date: Engineer and Superintendent, Mitsui Miike Metal Refinery, Mitsui Mining Co., Ltd., Tokyo, Japan.
Proposers: Takuma Dan, Tamaki Makita, Kojiro Nishimura.

**19—B. Marvel O'Harra,** Rolla, Mo.
Present position—1921 to date: Associate Metallurgist, U. S. Bureau of Mines.
Proposers: Charles Y. Clayton, Charles H. Fulton, Dorsey A. Lyon.

**20—Stanley Francis O'Leary,** Kingman, Ariz.
Present position—1921 to date: Manager, William C. Fastnow and Co. and Manager, Katherine Victor M. Co. and Manager, Oatman-Standard Mines Co.
Proposers: W. B. Phelps, Richard G. Place, S. Ford Eaton.

**21—Tokima Okitsu,** Sorachigun, Hokkaido, Japan.
Present position—1919 to date: Mining Engineer, Mitsui Sunagawa Colliery.
Proposers: Takuma Dan, Tamaki Makita, Kojiro Nishimura.

**22—Herman Phillippi,** Scheveningen, Holland.
Present position: Director of the Eerste Nederlandsch Indishe Hoogoven Maatschappy.
Proposers: L. Duparc, Max Reinhard, J. T. Erb.

**23—Leonard Cooke Phillips,** Durango, Mexico.
Present position: President and General Manager, Cia Minera Occidental, S. A.
Proposers: George H. Packard, J. A. Udden, E. L. Porch.

**24—Clifford Miller Roehrig,** Huntington, W. Va.
Present position—1921 to date: Consulting Engineer in business for myself.
Proposers: Newell G. Alford, Howard N. Eavenson, W. H. Cunningham.

**25—Yoshima Sayeki,** Tokyo, Japan.
Present position—1895 to date: Mining Engineer, Mitsui Mining Company, Ltd.
Proposers: Takuma Dan, Tamaki Makita, Iokichi Fujioka.

**26—Theodore Aloysius Schmidt,** Morris Run, Tioga County, Pa.
Present position—1912 to date: Mining Engineer, Morris Run Coal Mining Co.
Proposers: Theodore S. Barber, Douglas Bunting, Charles G. Morgan.

**27—Tsutomu Shibata,** Tokyo, Japan.
Present position—1915 to date: Mining and Metallurgical Engineer, Mitsui and Co.
Proposers: Takuma Dan, Tamaki Makita, Jokichi Fujioka.

**28—Mataroku Takagishi,** Sunagawamura, Sorachigun, Hokkaido, Japan.
Present position—1917 to date: Mining Engineer, Mitsui Sunagawa Colliery, Sorachigun.
Proposers: Takuma Dan, Tamaki Makita, Jokichi Fujioka.

**29—Toshiro Tsukamoto,** Ohmuta, Fukuokaken, Japan.
Present position—1921 to date: Metallurgical Engineer, Mitsui Miike Metal Refinery of the Mitsui Mining Co., Ltd., Tokyo, Japan.
Proposers: Takuma Dan, Tamaki Makita, Kojiro Nishimura.

**30—Lewis A. Turnbull,** St. Louis, Mo.
Present position: Assistant to Chief Engineer, Western Coal and Mining Co.
Proposers: C. R. Forbes, H. A. Buehler, A. W. Dickinson.

**31—Frank K. Weaver,** Olcott, W. Va.
Present position—1921 to date: Vice President and General Manager, Kanawha Black Band Coal Co.
Proposers: Charles E. Krebs, J. M. Clark, Ernest M. Merrill.

**32—Gosanji Yasnaga,** Kawakami, Karafuto, Japan.
Present position—1920 to date: Manager of the Mitsui Kawakami Colliery.
Proposers: Takuma Dan, Tamaki Makita, Jokichi Fukioka.

Associates

**33—Waldo Peck Adams,** Elizabeth, N. J.
Present position:
Proposers: Leonard Waldo, Philip W. Henry, W. N. Best.

**34—Francis Herbert Blatch,** Hazleton, Pa.
Present position: Assistant General Manager, Wilmot Engineering Co.
Proposers: George R. Wood, Herbert D. Kynor, H. W. Montz, T. E. Snyder.

**35—Herbert G. Buel,** Allentown, Pa.
Present position—1921 to date: Sales Manager, Tilghman H. Moyer Co.
Proposers: A. B. Jessup, C. A. Garner, Paul Sterling.

**36—Adolph Oliver Dovre,** Maracaibo, Venezuela, S. A.
Present position: Chief Geologist, Venezuelan Sun, Ltd.
Proposers: J. Whitney Lewis, Fred H. Kay, H. J. Wasson.

**37—Solomon Gilbert Drushel,** Edna, Texas.
Present position—1907 to date: President, Jackson County State Bank.
Proposers: E. G. Woodruff, J. A. Udden, D'Arcy M. Cashin.

**38—Homer Moore Eagles,** Brooklyn, N. Y.
Present position—1920 to date: Petroleum Engineer, James L. Darnell, Arthur Eaton, Engrs., New York, N. Y.
Proposers: Arthur Eaton, Ellis H. Phillips, D. S. Tovey.

**39—Walter Essington Eisenburg,** Los Angeles, Cal.
Present position: Student, University of Nevada School of Mines, Reno, Nev.
Proposers: J. C. Jones, F. C. Lincoln, Henry M. Rives.

**40—Le Roy Fowler Knight,** Scranton, Pa.
Present position: Engineer with Stevenson and Knight.
Proposers: M. S. Knight, George E. Stevenson, Cadwallader Evans, Jr.

**41—Donald Kenneth Mackay,** Tampico, Mexico.
Present position—1921 to date: Geologist, International Petroleum Co., Tobasco, Chiapas Field.
Proposers: W. Armstrong Price, Rex Townsend, A. W. Abraham.

**42—Laurence Stillman Morrison,** Redlands, Cal.
Present position—1921 to date: Geological Assistant to Mr. J. R. Finlay, New Mexican Mine Appraisal.
Proposers: J. T. Matson, J. R. Finlay, Cony T. Brown.

**43—Saburo Sugiyama,** Omuta, Fukuoka-ken, Japan.
Present position—1919 to date: Metallurgical Engineer, Mitsui Mining Co., Ltd., Mitsui Miike Metal Refinery, Tokyo, Japan.
Proposers: Takuma Dan, Tamaki Makita, Kojiro Nishimura.

**44—Alan Porter Sullivan,** St. Marys, Pa.
Present position—1920 to date: Research Engineer in charge of Research Laboratory, Stackpole Carbon Co.
Proposers: Frank J. Tone, R. L. Baldwin, F. A. Lidbury.

**45—Howard Volney Tygrett,** Bowling Green, Ky.
Present position—1921 to date: Geologist, Atlantic Oil Producing Co.
Proposers: Roswell H. Johnson, L. G. Huntley, R. E. Somers.

Junior Associates

**46—Eugene Randolph Aaron,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, T. M. VanTuyl.

**47—Irving Wyland Alcorn,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, M. H. Thornberry, Thomas M. Bains, Jr.

**48—Sherwood Buckstaff,** Madison, Wis.
Student, University of Wisconsin.
Proposers: E. R. Shorey, Richard S. McCaffery, A. N. Winchell.

**49—William H. Brugmann,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, H. B. Pulsifer.

**50—Beryl Elwood Charles,** Salina, Kansas.
Student, Missouri School of Mines, Rolla, Mo.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**51—Dewitt Clinton Deringer, Jr.,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, F. D. Aller.

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**52—Robert Marvin Edwards,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**53—George Newlin Ewing,** Philadelphia, Pa.
Student, Lehigh University, So. Bethlehem, Pa.
Proposers: G. A. Roush, Benjamin L. Miller, Howard Eckfeldt.

**54—Mervin Obert Flom,** Madison, Wis.
Graduate Student, University of Wisconsin.
Proposers: Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

**55—Muir Luken Frey,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: M. H. Thornberry, Charles Y. Clayton, Charles H. Fulton.

**56—Joseph Haskin,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, I. A. Palmer, Victor C. Alderson.

**57—James Stewart Huston,** South Bethlehem, Pa.
Student, Lehigh University.
Proposers: Allison Butts, G. A. Roush, Benjamin L. Miller.

**58—Norbert William Hyland,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, Victor C. Alderson.

**59—Charles L. Kofke,** Philadelphia, Pa.
Student, Lehigh University, So. Bethlehem, Pa.
Proposers: G. A. Roush, Howard Eckfeldt, Benjamin L. Miller.

**60—Roland Joseph Lapee,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, Thomas M. Bains, Jr., C. R. Forbes.

**61—Lawrence Litchfield, Jr.,** Cambridge, Mass.
Harvard Engineering School.
Proposers: H. L. Smyth, L. C. Graton, George S. Raymer.

**62—Edward Rutledge Loundes, Jr.,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, T. M. Van Tuyl.

**63—Thomas Seward Lovering,** Minneapolis, Minn.
Student, University of Minnesota.
Proposers: W. R. Appleby, W. H. Parker, Peter Christianson.

**64—Maurice Courtney McClellan,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, C. R. Forbes, C. L. Dake.

**65—William Christopher McCulloch,** Seattle, Wash.
Graduate Student, University of Washington.
Proposers: Joseph Daniels, Milnor Roberts, C. R. Corey.

**66—Edward G. Maddock,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, I. A. Palmer, Victor C. Alderson.

**67—Guy Verdier Martin,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, Thomas M. Bains, Jr., M. H. Thornberry.

**68—Carl E. Millikan,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, C. L. Dake, C. R. Forbes.

**69—Lute James Parkinson,** Golden, Colo.
1919–1922, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**70—Edwin Noel Pennebaker,** Berkeley, Cal.
University of California.
Proposers: Frank H. Probert, W. S. Morley, Oliver C. Ralston.

**71—Carleton Richardson,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, F. D. Aller.

**72—Elbert F. Robinson,** Berkeley, Cal.
Student, University of California.
Proposers: Frank H. Probert, Walter S. Morley, Lester C. Uren.

**73—Ambrose Chockley Rucker,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Suiteras, C. L. Dake.

**74—Christopher Winfree Ryan,** Golden. Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, T. M. VanTuyl, Victor C. Alderson.

**75—Paul Maxwell Sheriger,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, Victor C. Alderson.

**76—John H. Stoll,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Howard Eckfeldt, H. B. Pulsifer.

**77—James Taylor,** Socorro, N. M.
Student, New Mexico State School of Mines.
Proposers: T. W. Quayle, W. G. Ramlow, E. H. Wells.

**78—John Peter Withers, Jr.,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, Victor C. Alderson.

Change of Status—Associate to Member

**79—Daniel Boyd,** Phillipsdale, R. I.
Present position—1921 to date: Metallurgical Research with American Electrical Works.
Proposers: C. W. Drury, Stanley N. Graham, G. J. MacKay.

Change of Status—Junior Associate to Member

**80—Edgar Kraus,** Houston, Tex.
Present position—1921 to date: Geologist, Gulf Coast District, Atlantic Oil Producing Co.
Proposers: J. J. Galloway, W. G. Matteson, R. M. Raymond, D. M. Cashin, Donald C. Barton.

**81—Kenneth Murchison Sully,** Gibson, N. M.
Present position—1921 to date: Engineering and Construction work, Gallup American Coal Co.
Proposers: H. G. S. Anderson, John M. Sully, Horace Moses.

Change of Status—Junior Associate to Associate

**82—Eric Roy Emmerson,** Port Arthur, Ont., Canada.
Present position—1919 to date: Unemployed. Examining claims, prospecting, etc., when conditions and health permits.
Proposers: H. E. T. Haultain, George A. Guess, Frederick C. Dyer.

**83—Edward Meagher,** Brooklyn, N. Y.
Present position—1921 to date: Sales Department, Texas Gulf Sulphur Co.
Proposers: R. M. Raymond, Walter H. Aldridge, H. R. Wemple.

**84—Julien M. J. O. Raick,** Liege, Belgium.
Present position—Mining Engineer.
Proposers: Herbert Hoover, W. F. Dietrich, Theodore J. Hoover, W. H. Shockley.

## Do You Know Where These Men Are?

| Name | Last Address of Record from which Mail Has Been Returned |
|---|---|
| Abadie, Emile | Blue Mountain Gold Mine, Woody, Cal. |
| Alsdorf, F. C. | Inn Hotel, Shreveport, La. |
| Appleton, John R. | Colorado School of Mines, Golden, Colo. |
| Armstrong, Clifton T. | Pachuca, Hidalgo, Mexico. |
| Block, James A. | Resident Engr., Thacker Fuel Co., New Thacker, W. Va. |
| Blow, John J. | 404 High Holborn, London, W. C., England. |
| Bradley, D. H., Jr. | Box 93, Prescott, Ariz. |
| Carns, Foss D. | Arizona Binghamton Copper Co., Stoddard, Ariz. |
| Chang, Ko Chi | Student, Carnegie Inst.of Tech., Pittsburgh, Pa. |
| Chu, S. Y. | Columbia Univ., New York, N. Y. |
| Cleland, George A. | Miazza Woods Bldg., Meriden, Miss. |
| Crane, Guy Walter | Chief Consolidated Min. Co., Eureka, Utah. |
| Crocker, A. L. | 601 North West Bank Bldg., Minneapolis, Minn. |
| Dondero, F. Nicholas | Box 636, Ruth, Nev. |
| Fernau, J. J. C. | Hertion Wharf Works, Alferton, Wombley, London, England. |
| Frisbie, Howard I. | Race Track, Mont. |
| Granting, Hugo G. | Box 966, Warren, Ariz. |
| Gray, T. E. | Student, Colorado School of Mines, Golden, Colo. |
| Grebe, Emil. | Phoenix, Ariz. |
| Grubb, Everett L. | 620 N. Lake St., Madison, Wis. |
| Hatfield, Percy W. | 3312 Woolworth Bldg., New York, N. Y. |
| Hayes, Frederick H. | The Worthington Co., Inc., 510 Mills Bldg., El Paso, Tex. |
| Hill, Benjamin F. | 302 N. 4th St., Cripple Creek, Colo. |
| Hindshaw, H. H. | 617 Forest Ave., Ann Arbor, Mich. |
| Hoaas, Ole G. | 1644 Taylor St., San Francisco, Cal. |
| Hognason, Guy B. | Phoenix, Ariz. |
| Jones, Wendell T. | Apt. 3, 925 Pierce St., San Francisco, Cal. |
| Li, Chu | Student. Columbia Univ., New York, N. Y. |
| Lidvall, Edward Robert | 159 Pierpont Ave., Salt Lake City, Utah. |
| Lyons, Clyde Francis | Box 18, Tyrone, N. M. |
| McVey, Earle Yancey | Genl. Supt., Mine Office, Coal Beth Coal Co., Bentree, W. Va. |

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MARCH, HARRY, Councillor, Midland Institute of Min. Engrs., 17 Victoria St., Westminster, London, S. W., England.
MARSH, LESTER C....1319 Van Horn Road, Independence, Mo.
MARSTON, ROBERT L.....Carter Oil Co., Tulsa, Okla.
MORAES, JOSE E. A., Student, Colorado School of Mines, Box 31, Golden, Colo.
MORGAN, D. M.....407 W. 4th St., Joplin, Mo.
NIEMAN, HENRY W.....27 West 44th St., New York, N. Y.
NOBLE, CLARKE O., 120 S. Walker St., Albuquerque, N. M.
NUGENT, WILLIAM E., Colorado School of Mines, Golden, Colo.
O'NEAL, FRANK E..Gouleg Mountain Coal Co., Jodie, W. Va.
OLSON, VAN CLEAVE A.....Park City, Utah.
PELTON, HAROLD A.....Camp Lewis, Wash.
PERRY, RALPH G., Southern Illinois Engrg. Co., Herrin, Ill.
PONTON, G. M.....Westbrook Hotel, Fort Worth, Tex.
SANDS, W. E.....209 Ocean Front Ave., Venice, Cal.
SCHULER, HERMAN, Director, Agna Amarga Copper Co., Ltd., Vallenar, Chile, South America.
SHAYES, FRED P., Roxana Petroleum Corpn., Covington, Okla.
SMITH, RICHARD RAYMOND, Foreman, Moctezuma, Copper Co., Pilares de Nacozari, Sonora, Mexico.
STARR, CHARLES C., Supt., Tonopah Divide Mine, Tonopah, Nev.
STODDART, A. W....1251 St. Andrews Place, Los Angeles, Cal.
THOMAS, W. E., Cia Minerales y Metales, S. A., Apt. 251, Monterrey, N. L., Mexico.
TSEN, B. C.....Care Mrs. Cindburg, Sewaren, N. J.
TSENG, YIN LIAN....Blinjoe Banka, Dutch East Indies.
TURNER, ALBERT.....Box 517, Iowa Park, Tex.
UDE, G. EDGAR.....Box 933, Morenci, Ariz.
WATSON, HUGH C., Michigan-Colorado Min. Co., Bedrock, Colo.
WATTS, BLYTHE D., Sec., Lynite Laboratories, Cleveland, O.
WONG, YIN CHARLES, 414 W. 118th St., New York, N. Y.
YOUTZ, RALPH C., Calumet & Arizona Min. Co., Bisbee, Ariz.
YUAN, P. L., Care Mr. T. L. Yuan, Livingston Hall, Columbia Univ., New York, N. Y.

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HARRISON W. CRAVER, Director

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## Book Notices

**Architects' and Builders' Handbook.** By Frank E. Kidder. Seventeenth edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 1907 pp., illus., tables, 7 × 4 in., fabrikoid, $7.

Two new chapters, on Specifications for the Steelwork of Buildings, and on Domical and Vaulted Structures, have been prepared for this edition. The chapters on Fireproofing of Buildings and on Reinforced-concrete Construction and the sections on Heating and Ventilation and on Chimney Construction have been rewritten. The whole text has been revised and numerous new articles have been inserted. The book contains information on every subject, except design, likely to come before an architect, structural engineer, draftsman or builder.

**Atomic Theories.** By F. H. Loring. N. Y., E. P. Dutton and Co., 1921. 218 pp., illus., 9 × 6 in., cloth, $5.

Leading facts and theories relating to the atom, particularly the new ones which have not yet been treated at any length in textbooks. The book covers a wide range of subjects, including the quantum theory, Sir J. J. Thomson's recent views on mass, matter and radiation, the Bohr theory, the octet theory, isotopes, the Brownian movement, ionisation, potentials, solar phenomena, etc.

**Construction, Cost Keeping and Management.** By Halbert Powers Gillette and Richard T. Dana. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 572 pp., forms, 8 × 5 in., cloth, $5.

Prepared in response to requests for a second edition of "Cost Keeping and Management Engineering." Nearly all the original material, supplemented by that developed in the last twelve years. Explains rules of management and suitable methods of cost keeping adapted to engineering construction.

**Descriptive Geometry.** By George Young and H. E. Baxter. N. Y., The Macmillan Co., 1921. 310 pp., diagrs., 8 × 5 in., cloth, $3.25.

Believing that the chief value of descriptive geometry lies in its imaginative quality, these authors present it so as to develop the imagination. The treatment has been kept purely abstract, but introductory matter showing the relation of the principles under discussion to structural work is provided, and exercises to show the application of the abstract ideas to concrete, practical problems are included.

**Design of Steel-Mill Buildings and Calculation of Stresses in Framed Structures.** By Milo S. Ketchum. Fourth edition, rewritten. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1921. 632 pp., illus., diagrs., 9 × 6 in., fabrikoid, $6.

A textbook in structural engineering and also a book of reference for engineers. Part 1 covers the calculation of the stresses in simple beams, trusses, portals, the transverse bent and the three-hinged arch. Part 2 covers the calculation of the deflections of structures, the stresses in statically indeterminate girders, trusses and frames, and secondary stresses in trusses. Part 3 covers the design of steel frame buildings for mines, mills, smelters and other industrial plants. The appendix is a complete specification for steel-frame mill buildings.

**Edge Moor Water Tube Boiler.** Edge Moor, Del., Edge Moor Iron Co., 1922. 153 pp., illus., 9 × 6 in., cloth.

Contains data on oil firing, waste heat recovery, properties of fuels, water purification, steam tables, etc., in addition to technical information concerning the Edge Moor boiler.

**Die Eisenkonstruktionen.** By L. Geusen. Dritte, verbesserte auflage. Berlin, Julius Springer, 1921. 282 pp., diagrs., tables, 11 × 8 in., cloth, 384 Mk.

Textbook for students of structural engineering. Section 1 gives the principles of steel construction; Section 2 deals with steel buildings and Section 3 with bridges. The text is concise and illustrated by numerous drawings. An appendix contains the necessary tables of the properties of structural shapes.

**Elements of Fractional Distillation.**—By Clark Shove Robinson. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. (International chemical series.) 205 pp., tables, diagrs., 8 × 6 in., cloth, $2.50.

The first portion of this book treats of fractional distillation from the qualitative viewpoint of the phase rule; the second discusses some quantitative aspects from the engineering point of view; and the third section treats of the design of distilling apparatus. Part four gives examples of modern apparatus for distilling ammonia, benzolized wash oils and alcohols. An appendix of useful tables is included.

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**Essentials of Industrial Costing.** By George S. Armstrong. N. Y., D. Appleton and Co., 1921. 297 pp., tables, forms, 9 × 6 in., cloth, $5.

This book is concerned solely with the principles and methods by which the cost of production may be determined. It is based upon an extended experience in many different industries and represents the author's mature views. It shows the purpose of costing, summarizes good practice and is a guide to the analysis necessary for the establishment of costing systems.

**Handbuch der Drahtlosen Telegraphie und Telephonie.** By Eugen Nesper. Berlin, Julius Springer, 1921. 2 vol., illus., diagrs., 10 × 7 in., cloth.

This book is apparently more extensive than any previous work on the subject. The theory of radio communication, its history, uses, measuring and detecting instruments, physical phenomena in quasi-stationary circuits, coupling, damping, radiating, technique and apparatus of high-frequency measurements, are described in Volume 1. Volume 2 describes typical radio stations for different purposes and their apparatus, the uses of radio communication in railroading and radio telephony. It also includes a valuable bibliography of the important books and articles. Good indexes are provided.

**Hydraulics and Its Applications.** By A. H. Gibson. New edition, revised and enlarged. N. Y., D. Van Nostrand Co., 1921. 813 pp., illus., diagrs., 9 × 6 in., cloth, $6.

This book gives a description of the physical properties of water, followed by a brief treatment of the fundamentals of hydrostatics. The science of hydraulics is then presented, first theoretically and then with regard to its application to the design of hydraulic machinery. The work is primarily for students, but may also be valuable to those actively engaged in the practice of hydraulic engineering.

**Industrial Fatigue and Efficiency.** By H. M. Vernon. Lond., George Routledge & Sons, Ltd.; N. Y., E. P. Dutton & Co., 1921. 264 pp., tables, 9 × 6 in., cloth, $5.

The author is an investigator for the Industrial Fatigue Research Board of Great Britain and presents a fairly complete account of our present knowledge concerning industrial fatigue and its influence on efficiency. The information given relates only to shop practice.

**Manual of Flotation Processes.** By Arthur F. Taggart. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 181 pp., diagrs., 9 × 6 in., cloth, $3.

Widespread understanding of the physical principles underlying flotation phenomena and of the diversity of flotation processes has been delayed, partly by the apparent complexity of the phenomena and the difficulties of investigation, in part by the attitude of corporations owning patents on flotation processes. It is the purpose of this book, in part, to counteract the further spread of false conceptions, by setting forth some of the facts that contradict them, in part to describe apparatus and methods of testing which will aid investigators in their researches; and finally to give some generalizations from mill practice, by means of which the investigator may translate laboratory results into commercial operations.

**Maschinenuntersuchungen und das Verhalten der Maschinen im Betriebe.** By A. Gramberg. Zweite, erweitete auflage. Berlin, J. Springer, 1921. (Maschinentechnisches versuchswesen, bd. 2.) 681 pp., illus., 9 × 6 in., cloth.

Volume two of the author's treatise on methods for testing machines, the first volume of which is devoted to measuring apparatus. This volume discusses methods of testing and the behavior of machines while running. The subjects treated include boiler tests, fuel tests, heat conductivity, steam turbines and reciprocating engines, exhaust steam utilization, internal combustion engines, pumping machinery, blowers, air compressors and refrigerating machines. A section is devoted to regulation and governing. An introductory section discusses the economic and legal aspects of tests.

**La Matière et l'Énergie Selon la Théorie de la Relativité et la Théorie des Quanta.** By Louis Rougier. Nouvelle édition, revue et augmentée. Paris, Gauthier-Villars et Cie, 1921. 112 pp., 10 × 7 in., paper, 9.50 fr.

This book calls attention to the most paradoxical and least discussed consequence of the principle of relativity, that which constitutes mass, weight and structure to energy. What we call matter thus becomes only a particular case of energy. The old duality of ponderable and imponderable makes way for that of the electro-magnetic field or *energy*, of which radiation and matter are simple modalities, and of the field of gravitation or *space* as defined by Einstein. Professor Rougier presents these theories in this work.

**Metallurgy of Zinc and Cadmium.** By H. O. Hofman. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 341 pp., diagrs., tables, 9 × 6 in., cloth, $4.

This volume resembles the author's previous treatises on copper and lead in its general characteristics and, like them, is supplied with copious references to the literature. Includes recent advances in the metallurgy of zinc and cadmium, and discusses these from a chemical as well as a technical point of view.

**Motor Truck Transportation.**—By F. Van Z. Lane. N. Y., D. Van Nostrand Co., 1921. 153 pp., illus., 9 × 6 in., cloth, $2.

A practical presentation of the principles of truck operating cost; operating efficiency and cost records; operating cost laws; truck details, such as bodies, loading and unloading devices, trailers and semi-trailers, and tires; and the factors that determine the fields of economical operation. Gives no attention to design or manufacture.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau for one month.

Positions of the Bureau are on file in the offices of the member societies of the Federated American Engineering Societies and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Mining Executive.**—Technical education and practical experience in developing and operating anthracite, bituminous, copper and gold properties. 28 years. Special service or official capacity. IM–1538.

**Mining and Metallurgical Engineer.**—Graduate. Experience as assayer, chief chemist, sampler, engineer, hydrometallurgy of copper, two years foreign exploration and development. Age 30. Single. Minimum salary $3000. On foreign work necessary traveling and living expenses in addition to salary. IM–1539.

**Mining Engineer.**—Twenty years practical experience in development and operation of anthracite and bituminous mines. IM–1540.

**Quarry and Open-cut Operator.**—Has made specialty of surface mining of large orebodies, big tonnages and low unit costs. College man, age 39, married. Eight years experience in the United States and seven in Mexico, in gold, silver-lead and copper properties, underground, surface operations, construction, efficiency and cost analysis. Speaks Spanish fluently. Available after Dec. 1, 1921. IM–1541.

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**Recent Graduate.**—E. M. metal mining and geology. New York interview. IM–1542.

**Superintendent or Mining Engineer.**—Columbia graduate. Nine years superintending mines, chiefly coal; two years consulting mining engineer in coal field. Considerable construction experience. Practically and technically trained to manage operations or act as chief engineer. Age 35. Married. IM–1543.

**Mining Engineer.**—Design and construction of coal tipples, power plants and general machinery. Surveying, mapping and general coal-mine development. Experienced draftsman in all work. IM–1544.

**Engineer.**—Desires position as instructor or assistant in teaching mining engineering, coal mining or civil engineering subjects in college. Master of Science degree. Some teaching experience and over five years practical work. IM–1545.

**Engineer.**—Twelve years in construction design and executive management. Desires to locate west or south of Denver. Speaks Spanish. Experience includes bridges, reinforced concrete, buildings, hydraulics, hoisting, conveying, aerial tramways. Development, design and selection of equipment for plants handling copper ores a specialty. Familiar with leaching and smelting. Can select and supervise men and meet executives of other concerns with tact and success. IM–1546.

**Petroleum Geologist.**—Graduate. Experience in Mid-continent fields. Wishes position in United States. IM–1547.

**Metallurgical Engineer.**—Columbia graduate; successful research and operating experience in iron and steel and nonferrous alloys. IM–1548.

**Material Engineer.**—Technical graduate. Five years experience in specifying materials, drafting purchasing specifications, and general metallurgical work on the consuming end. One year as metallurgist in a steel plant. Position in purchasing as director of research, or along metallurgical lines. IM–1549.

**Manager or Superintendent.**—Construction or operation. Seventeen years surface and underground mining, and in concentration plants, principally non-metallics. Now developing and marketing raw materials. Position preferably in Southeastern States. Age 37. IM–1550.

**Chemical Engineer.**—Seven years as production superintendent in Chile. Experienced in leaching ore, treatment of slimes, filtration, etc. Thoroughly familiar with Spanish. IM–1551.

**Mine or Quarry Manager.**—Technical graduate, 10 years' experience in South America, United States, and India. Last 2½ years in charge of about 5000 labor in open cut mines in India. Age 33. Married. Speaks Spanish. IM–1552.

**Mine Manager or Assistant.**—Technical graduate. Postgraduate business course. Successful independent business experience. Five years in mining, geology, and milling. Age 29. Married. Speaks Spanish. Available 3 to 6 months notice. Present salary $6000. IM–1553.

## Positions Open

**Transmission Line Superintendent.**—Applicant must be conversant with practice in transmission lines 100,000-volt, three-phase, 50-cycle; must be capable of taking entire charge of transmission system of approximately 400 mi. of line; must be familiar with both construction and operating work; and must be capable of handling native help. Reply, stating age, experience, training, and salary desired. India. X–1292.

**Graduate Mechanical Engineer** experienced castings and structural iron, design for job and small quantity production. Design wet chemical and metallurgical plants, acid-proof work, able to meet engineers and inspire confidence. Handle draftsman efficiently, preferably some plant operating experience. Prefer single active man between 30–35 years, prepared to hustle hard to learn business. Accuracy and carefulness absolutely essential, business training desirable. New York. V–284.

**Mining or Metallurgical Engineers.**—To study fertilizer business from manufacturing end. Young men, preferably around 30, whom we could send around to various plants to check processes, economies, machinery installation, etc. and to study details of plant operations. Slight knowledge of Spanish woud be beneficial as we have two plants in Cuba. Give age, education and experience. Chicago, Ill. V–295.

**Engineer.**—To take charge of machine and iron foundry. Average of 20 to 30 tons per day, of general foundry castings; most of work averaging fair weight. We have one loam job, making cylinders for dryers used on paper machines, but very little other loam work. General line is paper-making machinery. V–296.

**Competent Mine Foreman.**—To take charge of small operation where work is being done underground with overhand stoping. Prefer young technical graduate, with at least two years practical experience underground. North Caroline. V–266.

**Mining Engineer.**—Experienced in extracting gold by the cyanide process. Must have good personality and be able to advertise and sell process. South Africa. V–268.

**Engineer.**—To run flotation plant treating 10,000 tons per month of cyanide tails pumped to mill. V–252.

**Engineer.**—To run main unit of mill, which is concentration and flotation plant treating 6000 tons per month low-grade silver ore. V–253.

**Geologist** with 5 years experience in oil geology. Knowledge of Spanish for work in tropics. V–247.

**Technical Graduate.**—Preferably mechanical, with four or more years of practical experience with boilers, engines and electrical equipment and two or more years experience in college teaching. Ability to write on technical subjects in popular style is absolutely essential. Give details regarding training, experience, references, and salary desired. V–248.

**Engineer** for advertising field. Prefer man who has had at least five years' business experience in metal-trade field. Must be able to take first-class photographs of machinery and machine-shop interiors. Duties would entail traveling more or less so he would also have to have some knowledge of repairing and driving of automobiles. Application by letter. V–180.

**Surgeon** for company in Chile. Single man preferred. V–272.

**Engineer.**—To take charge of management department of a real-estate office. Must have had actual experience in renting and operating high-class office building. New York City. V–303.

**Assayer** having considerable experience melting and assaying gold, silver and platinum. New York City. V–307.

**Mine Foreman** with bituminous coal mining experience. Scientific management experience also essential. V–355.

**Research Graduate Assistantships.**—For detailed information, write to The Director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

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**Union of Friends of the Mining Academy of Freiberg** was founded on Dec. 3, 1921. It purposes to support the Mining Academy in its problems of research and instruction, to assist students, and to form a permanent connection between the high school and its former students and associates. The chairman is Dr. Inge. K. Sorge, chairman of the Federal Union of German Industry; the office is at the rectorate of the Mining Academy. The society requests former students and friends to become members.

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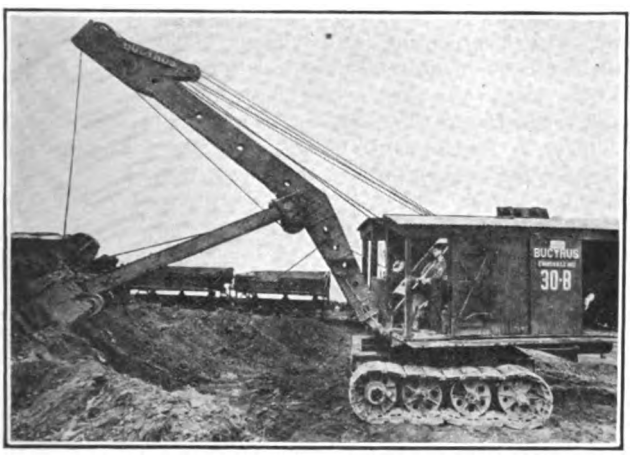
# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

## Gasoline Revolving Shovel

A SHOVEL operated by gasoline, with no engines, motors, shafts, chains or gears on the boom and yet with an actual digging power greater than a steam shovel of the same size, has been announced by the Bucyrus Company of South Milwaukee, Wis. This machine is known as the 30-B gasoline shovel.




BUCYRUS 30-B GASOLINE SHOVEL LOADING DUMP CARS.

For more than 10 years Bucyrus dragline excavators have been operated by gasoline engines, but the application of this power to the revolving shovel involved more difficult and intricate problems, chief among these being the efficient transmission of power to the thrust without excessive complication in design, and the obtaining of digging power commensurate with that of a steam machine of similar size. Both of these problems have been satisfactorily solved in this new shovel.

This shovel is simpler than a steam, electric or other type of gasoline shovel and has fewer parts to maintain and keep in order. It has all the well-known performance characteristics of a steam shovel, even to the shaking of the dipper to relieve it of sticky material. It will give 20 per cent. greater yardage per gallon of gasoline than an electric shovel of the same size, or than any other type of shovel whose power is derived from a gasoline engine. The shovel carries a 1-yd. dipper.

The gasoline engine with which this shovel is equipped was designed especially from specifications offered by the Bucyrus engineers. It is a four cylinder, slow-speed type and will develop 55 hp. at a speed of 400 r.p.m. It is entirely inclosed and thus dust proof.

A bulletin has recently been issued describing and illustrating this machine in detail, which may be obtained from the Bucyrus Company.

## Romance of Wire Rope

"OUTSPINNING the Spider" is the title of a small book by John Kimberly Mumford, published by R. L. Stillson Co., New York. For the most part it relates the growth of wire making as reflected in the growth of the John A. Roebling Sons Company.

The book is written in a popular vein, understandable to the layman, and is in no sense technical.

The first Roebling rope was finished in 1840. John Roebling had a vision of the part that wire rope was to play in the industrial development of the world and from the start realized the universal mission of twisted wire.

Wire cableways for hauling material over rivers and gorges soon ceased to be a novelty. Despite the opposition of engineers and others, by 1844 Roebling had not only perfected his theory of wire bridges, but in spite of criticism had built a wire bridge as an aqueduct for the Old Pennsylvania Canal, the basins of which were at Pittsburgh. This was followed by the construction of a wire bridge over the splashing and fuming waters of Niagara, the first of its kind to carry railroad traffic.

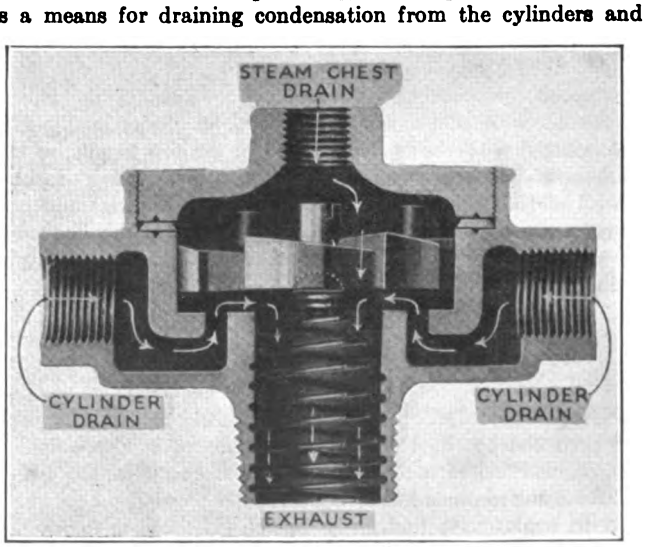
Speaking of this accomplishment, the author says: "All the world of that day knew, but most of it now has forgotten, how he (John Roebling) flew a kite across the gorge to get his first wire over and from that built up his cables. On March 16, 1855, the first train passed over it."

The summit of achievement in the building of bridges of wire came with the construction of the Brooklyn Bridge, considered the Eighth Wonder of the World. It was while occupied in this work that John Roebling sustained a slight injury that resulted in his death.

"Outspinning the Spider" relates in a vivid way the various processes used, the exacting care necessary and a few of the various uses to which wire rope is put.

## Automatic Drain and Relief Valve

THE Improved Diel-More Automatic Drain and Relief Valve is for use on all reciprocating, steam-operated equipment as a means for draining condensation from the cylinders and steam chest. It is entirely automatic in its operation; the relief feature takes care of any over-load pressure in either end of the cylinder while the engine is operating.




DIEL-MORE AUTOMATIC DRAIN AND RELIEF VALVE.

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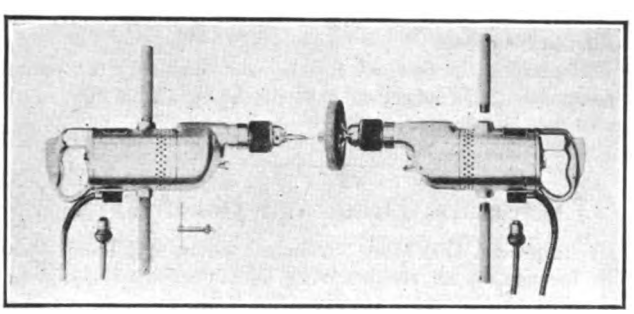
In starting the engine, when it is at rest, an adjustable spring raises the disk-valve proper, thereby permitting water to escape through by-passes to the waste-pipe. When the engine is operating, the disk valve is seated by the pressure carried in the steam chest, thus any excessive pressure accumulating in either end of the cylinder, due to priming or other causes, will instantly overbalance the pressure on the top of the disk valve, opening both cylinder drains and permitting water to escape from one end of the cylinder and, at the same time, relieving steam pressure in the other end.

Although the Diel-More Valve automatically performs the functions of a drain and relief valve, it has produced a marked saving of cylinder oil and steam, and greatly extends the life of packing in the stuffing boxes. It is made entirely of brass, and has only one moving part, the disk-valve proper. The spring that supports the disk valve is adjustable. The valve is fully guaranteed, and actual service over a long period has demonstrated that its efficiency of operation is not in the least impaired.

There is also a Diel-More one-way valve for apparatus that carries a high pressure, with only one outlet to be drained. This is automatic, but without the relief effect; it opens when the pressure is removed from the valve disk and closes when pressure is applied.

## Portable Electric Drill and Grinder

THE new "Wodack" Combination Portable Electric Drill and Grinder, made by the Wodack Electric Tool Corpn. of Chicago, has a drilling capacity of ⅛ to ⅝ in. in steel, and when used as a grinder carries a 6 by ¾ in. grinding wheel. Two speeds are provided, the slow speed for drilling and the



WODACK PORTABLE ELECTRIC DRILL AND GRINDER.

high speed for grinding. The complete weight of the tool is but 18 lb., while the motor develops ½ hp. under load. This tool is fitted with the switch located in the top handle, of the quick-make-and-break automatic-stop type, which insures control of the tool at all times. Aluminum castings and ball bearings are used throughout. The motor is of the Universal type, and therefore can be operated on both direct and alternating current of the same voltage.

## Dumorite a New Dynamite

A NEW "powder," known as "Dumorite," has just been perfected by the Du Pont Co. It is made with a double base of modified nitroglycerin and guncotton; it cannot freeze and does not produce headache. The Du Pont Co. announces that the explosive will effect savings of one-third on the dollar. It is as powerful stick for stick, under ordinary conditions, as regular 40 per cent. dynamite, and each case contains approximately one-third more sticks.

Dumorite is a free-running explosive. Tests have proved that it is especially adaptable for open work in quarries, construction and agricultural fields, for blasting hard rock and hard ores where the ventilation is good and for use in bituminous coal mines where a permissible is not required and where a large production of lump coal is desired.

## Industrial Notes

**Dayton-Dowd Co.**, Quincy, Ill., has opened an office at 809 Keenan Bldg., Pittsburgh, Pa., which is in charge of T. J. Barry, who has been connected with the home office for several years.

**Rathbun Jones Engineering Co.**, Toledo, Ohio, has appointed the Ingersoll-Rand Co., New York, general sales agent for Rathbun gas engines.

**H. W. Hardinge** sailed on Feb. 15, to attend to business of the Hardinge Company, especially connected with the Quigley Fuel Systems, in England, Belgium, France and Italy. He will return in about two months.

**McClellan & Junkersfeld**, 141 Broadway, New York City, is a new Delaware corporation for engineering and construction work. The incorporators are William McClellan, president of the American Institute of Electrical Engineers, Peter Junkerfeld, for many years connected with Edison companies of Chicago; and Horace T. Campion, of Philadelphia.

**William F. Parish**, 2010 Peoples Gas Bldg., Chicago, Ill., announces the opening of a petroleum analytical and experimental laboratory.

**American Carbonization Co.**—Howard R. Swearer, Edward C. van Asmus, Lloyd F. Schrader—has removed its offices to 212 5th Ave., New York.

**The Photostat Corporation**, 299 State St., Rochester, N. Y., has recently made some improvements in its "photostat," or photographic copying machine. The chief feature of the machine is its all-metal construction, making it durable and light in weight. The machine is made in the same sizes heretofore furnished.

## Trade Catalogs

**E. Vernon Hill Co.**, 64 W. Randolph St., Chicago.—Aerological instruments and the Psychrobook, which contains the psychrometric charts, 5-in. thermometer, absorbent paper, and note paper.

**Braun-Knecht-Heimann Co.**, 584 Mission St., San Francisco, Calif.—Bulletins describing portable prospecting and blowpipe outfits; metallurgical furnaces and burners designed for oil, gas, and gasoline; and laboratory machinery.

**Jeffrey Mfg. Co.**, Columbus, Ohio.—Catalog 345, Coal and Ashes Handling Machinery for Boiler Houses. Twelve types of Jeffrey power house equipments are illustrated and described in this catalog.

Bulletin 360. Portable Car Unloader.

**Hardinge Company, Inc.**, New York, N. Y.—Bulletin 12 on Quigley Fuel Systems, gives considerable space to the methods of preparing, transporting, and burning the fuel.

**Quick Repair Washer Co.**, Traction Terminal Bldg., Indianapolis, Ind.—Circular describing quick repair washer manufactured for mining machines, mine cars, etc.

**Pneumelectric Corpn.**, Syracuse, N. Y.—Circular describing the Pneumelectric Friction Hoist, which has been built for drag-line or scraper-loader service.

**By-Products Recoveries**, 328 Seventh Ave., New York City.—Bulletin 326, Dry Dust Collectors, Reverse Nozzle Type.

**Arthur D. Little, Inc.**, Cambridge, Mass.—Bulletin entitled Valuation Reports and Engineering Appraisals, which is sent out by the Valuation Department of the company, 330 Munsey Bldg., Washington, D. C.

**Triplex Machine Tool Corpn.**, 18 E. 41 St., New York City.—Catalog No. 1, Triplex No. 1 Machine Tool, for turning and boring, milling, thread cutting, drilling.

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# MINING AND METALLURGY

APRIL 1922


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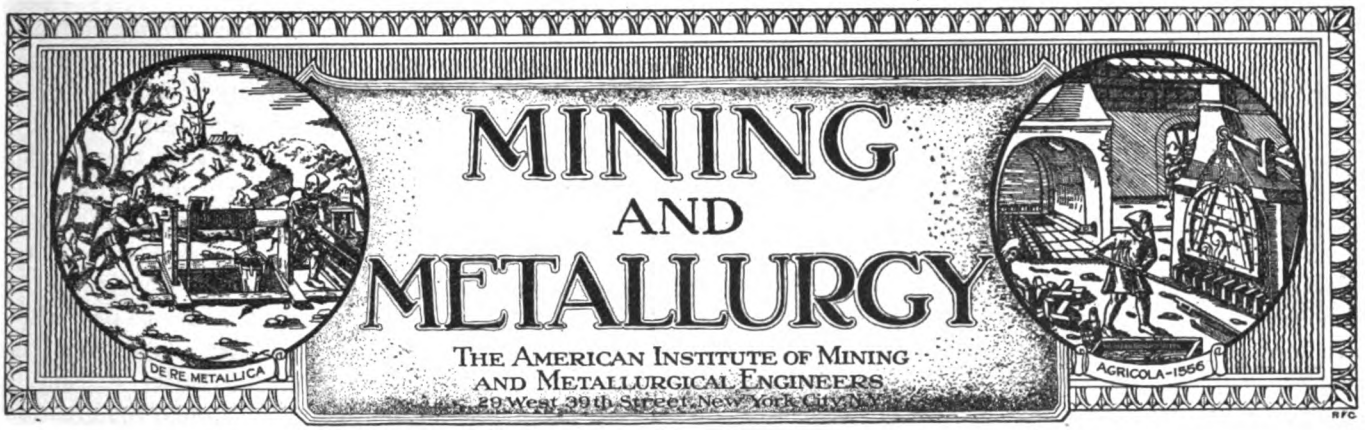


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## EDITORIAL

### How Do Things Stand?

RIGHT after the Armistice and lasting to about the advent of spring in 1919, there was a period of gloom and depression out of which there came a concerted effort to start a "sunshine" movement. I shall be far from ascribing to this the ensuing boom of 1919–20, but it was contributory, and a vastly more severe penalty was paid than if things had been let alone. There are those who would like to institute something artificial now. This thought has drifted down to the classes that—well, that are not trained in economic thought. I attended a vaudeville a few nights ago where in the course of the entertainment a youthful gentleman, who was really serious, sang a song of which the several verses began with the words "Hello, Prosperity!" the burden of the subsequent advice being that if everybody who had a wad would loosen up and enter upon a career of profligacy hard times would soon be over, which sentiments were warmly applauded. Considering that professional Wall St. is in the same mood, we should not be hypercritical; but a "sunshine" movement, a renewed period of inflation, or whatever it may please anybody to call it, in the present juncture would be a real calamity.

There has been no improvement in economic conditions beyond the nature of little ripples on the surface of a lake. Indeed, the sober observer of world-wide affairs finds it difficult to avoid the conclusion that things are becoming worse. The recent studies of Bass and Moulton, Friedman, Keynes, and Vanderlip, together with my own, while representing views from different angles, are remarkably unanimous in their conclusions as to the gravity of the state of affairs.

About the best index of industrial activity is the number of workers who are employed. In Germany, where there is the greatest activity in Europe, the percentage of employment, according to the latest



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reports, was about 97½. In the Netherlands it was about 92½; in Belgium about 86; in Great Britain about 83; in Norway about 81; in Denmark about 80; in Sweden about 73. Such data for the United States are not available, but more or less conjecturally we had a rate of about 87 per cent. at the minimum, and possibly it is about 90 per cent. now.

Percentages of employment have to be modified by factors of efficiency. There is considerable evidence showing general impairment of efficiency in Europe. In the United States there is a good deal of confusion on this subject. In some lines of work our men are now functioning with a high degree of efficiency; and in others not so. I should hesitate to venture into any generalization on this subject. It is clear, however, that we can make positively the generalization that among the workers of the civilized world there is at present a low degree of activity. In this respect the labor statistics are supported by the production statistics in so far as they are available.

Outside of these data it is clear, moreover, that an abnormal part of the world's capacity for production is being absorbed by the functions of government, which is a sort of negative production. The British governmental budget for the coming year calls for governmental revenue to the amount of about £950,000,000, which will probably be about one-third of the national production. The French budget also calls for about one-third of the national production. In the United States the cost of government—federal, state and municipal—is conservatively reckoned at the rate of about seven billion dollars per annum. Some authorities estimate eight billion. These figures include interest on debts, and in so far as the latter are internal, this implies merely the transfer of income from one group of people to another, but even after segregating such items there is in every country a greatly swollen absorption of the national earning power for the purposes of government. Manifestly, while this condition continues to exist, the ability of many people to save out of their earnings for the building of houses, railways, public improvements, etc., is curtailed.

A further curtailment results from derangement of the division of earnings among groups of workers, *e.g.*, as when the railway workers, controlling an essential function of economic affairs are able, by virtue of concerted action and the support of laws enacted in their favor, to maintain the capture by them of a disproportionate share of the national income. The railway workers are cited merely as an example, for there are other classes that have succeeded in doing the same thing. If those classes were generally thrifty, there would be no alteration in the national position as a whole, although there would be discomfort and discontent among the other classes that had been victimized; but when the favored or predatory classes, however one may please to characterize them, having appropriated the earnings that other people used to save, proceed to spend them for automobiles, moving pictures, phonographs and other luxuries, there is a direct subtraction from the national ability to create capital goods which is the only foundation of real prosperity.

We have, therefore, at the present time there major conditions of adversity, *viz.* (1) a generally low scale of activity; (2) the absorption of a greatly increased proportion of national earning power for governmental purposes; and (3) a derangement in the division of the proceeds of production which contributes to profligacy in expenditures. To these may be added that the overbuilding of industrial capacity, after causing a direct waste of labor and material through the creation of unnecessary plant, has saddled each overbuilt industry with an unnecessarily large overhead expense and has attached to each of them an unnecessarily large personnel.

Even in a country that suffered as little as the United States, and which is so rich, these conditions have had, and will continue to have, serious consequences. At first we did not notice them. When our house building was checked we had the normal surplus on which to draw. Similarly we made our railway plant answer our purposes by dint of crowding and at the expense of inconveniences and delays. We neglected repairs to our buildings and stinted the supply of fertilizers to our fields. Perhaps the most immediately evident of our decadences was in the impairment of our tramways, whereof we saw, in some cases, entire lines abandoned. The things that I have mentioned are not mere conjectures or matters of opinion, but are shown positively by statistics. All of this meant, of course, that we were living on our fat. We have done, and are doing, this in other ways. For example, in order to keep themselves going our manufacturers have had to reduce the prices for their goods. With little or no abatement in labor costs, in many cases the only expedient was to skimp in materials. At present many articles are paraded as being offered at pre-war prices, which may be true, but often they are not the pre-war articles, though they may look like them. When a man who used to get for $10 a pair of shoes that would last for 10 months receives for that price a pair that will last for only six months he suffers an economic impairment that is just the same as if he has to let his house decay from lack of painting.

Without any question the people of Europe have been reduced to a lower scale of living than they had before the war. I am inclined to think that we of the United States are also already on a lower plane, speaking generally. Of food and clothing we have enough for our needs; of housing, we have not; of transportation facilities, we have not. No one who is compelled to ride daily in the subways of New York is under any delusion that he is as well off in that particular as he used to be. Still less are those suburban dwellers who lost their trolley lines altogether.

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Between the middles of 1915 and 1920 many classes of people came into the enjoyment of luxuries that they had never had before, but in the main that was at the expense of the national principal, as a whole. Since the middle of 1920, when the readjustment began, this benefit has been preserved by a few classes at the expense of the whole and especially more and more at the expense of other classes of workers. The favored classes consist largely of the members of labor unions, who number about 5,000,000 workers, including the members of the A. F. L. and the railway brotherhoods, together with those who are not at present paying dues but are regarded as sympathizers; and non-unionized workers in trades and vocations requiring long training, who have for that reason been able so far to withstand competition. These are the aristocrats of labor.

The railway workers, besides being banded in their unions, are protected by Federal laws. The grotesqueness of the situation is reflected by the fact that for some kinds of work for which the railways are required to pay about 40 cents per hour the outside market price for the same, in the same towns, is 25 cents. Some of the railways are meeting this condition by turning over branches of their work to contractors who can employ men at the going rate which they, themselves, having been macadoodled, are not permitted to do. This is not a story from "Alice in Wonderland."

The upshot of all this is that while the farmers and miners (including the mine stockholders) have lost their buying power, the prices for raw materials having shrunk to about pre-war levels (in some cases lower), the prices for goods at retail have come down but little, and when nominally they have it is frequently merely because the goods have been shoddied. The cost of having anything repaired is often prohibitive. So long as these weirdly unsound conditions obtain there is no ground upon which to base hopes for prosperity, or even a return of normality in business.

We can not have any return to normality until Europe is able to buy from us again in something like the old way, and that is far distant; but we can have great domestic activity in replenishing our depleted stocks of goods and in supplying the housing and transportation facilities that we need. That is not to be expected, however, until the existing maladjustments have been corrected. There is not going to be any enduring prosperity merely by invoking it, or wishing for it or kindling false sentiment.

The prevalent theory notion that business improvement will begin soon is based upon hope rather than reason and it is to be feared that it is being cultivated by those who expect to realize ephemeral profits from it. If such a premature improvement happens it will be harmful, for it will only delay the completion of the readjustment that alone can lay the foundations for permanent improvement. At the present time the "optimists," so-called, are mischief-makers. So are those who are planning great expenditures for highways and other governmental improvements with a view to making work; and so are those who may try to arrange compositions with labor, which if successful can do nothing but prolong the agony. The existing economic evils are not going to be cured by shouting "Hello, Prosperity!" but they will be overcome most quickly by facing the facts.

The present position of the American people may be summarized in this way: A diminished production, as compared with 1913; a curtailed export market; a greatly increased subtraction for governmental purposes (high taxes). Out of the remainder a disproportionately large allocation to certain classes of labor and by them continued squandering of the proceeds. These conditions are evident to anybody who stops to think about them. I have no doubt that they are appreciated even by Samuel Gompers. He is acting, however, in behalf of his particular group of about 4,000,000 union members and has his hands full in restraining the red, radical elements among them, which want to plunder.

W. R. INGALLS.

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## Revision of the Mining Law

HEARINGS on the revision of the mining law before the House Committee on Mining were scheduled for the first weeks of March. Owing to the wide publicity given to the Arentz Bill, which was drafted by a committee of engineers appointed by the Bureau of Mines, a voluminous amount of correspondence and technical notice has been given to the details of this bill. Careful scrutiny of all of this material reveals some interesting facts. It is clear that most of the people who are criticizing the bill have not read it intelligently. Intelligent criticisms are to the effect that the time prescribed for holding a claim without discovery is either too long or too short, or that the method outlined for recording claims is too onerous, or not enough so, etc., etc. The large amount of aimless and sometimes vituperative criticism may be disregarded and notice taken only of the constructive criticisms. These pertain to practically five points.

A fundamental idea of the committee's bill is the abolition of the law of the apex. However, that can not be done without doing other things. With abolition of the law of the apex, abolition of discovery as a prerequisite to location follows necessarily, for otherwise there would be no means of locating the extension of a vein dipping beyond the vertical planes of the original location. Moreover, there are orebodies that do not appear on the surface at all, wherefore it is impossible to make any superficial discovery. With abolition of discovery as a prerequisite, it follows that there must be some time limit for holding a claim.

The committee, in drawing this bill, strove to pre-

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serve the wealth of legal decisions that have been built up by years of patient application.

The question of requiring discovery as a prerequisite to location under the present law leads to moral corruption of everyone connected with the claim. Everyone knows that most locations are made where the discovery shaft can be sunk with the least effort and expense, and the discovery of mineral in place is in the majority of cases pure fiction. Under the new law a location can be held for five years without discovery and then on the annual payment of a stated fee can be held for another period of five years. This not only gives the old prospector all the opportunity which he has now of developing his property, without perjuring himself when he records his location notice, but it gives the large companies with capital an opportunity to do the extensive drilling that must precede the probable discovery of any large orebodies in the future.

If at any time during the original five years or the subsequent extension an actual discovery is made, the holder must proceed to patent within seven years from the time of the original location, unless extended by the exploring right to 12 years. There has been much misunderstanding about this section of the law which, like all the other misunderstandings, results from inadequate study and failure to comprehend what the English language plainly states.

The question of locating claims on cardinal lines is a minor one from the standpoint of the Revision Committee and will be conceded to the opponents without argument. It was suggested only as a desirable thing and not as an essential one.

The size of the mill sites has been a subject of misunderstanding. The little old five-acre mill site per claim, which was ample for a 10-stamp mill, is utterly inadequate for the large porphyry properties of today with immense tailing ponds and the disposal of overburden and stripping which has come to be a common problem to all steam-shovel properties. Under the present law it is almost impossible for an engineer or a company to obtain sufficient ground for these purposes without resorting to various subterfuges to accomplish those things which everybody wants to accomplish, including the prospector and the public at large, but is prevented from doing by the rigid but inadequate provisions of the law. In other words, under the new law an engineer and manager does not have to leave his conscience at home while he is accomplishing these necessary acquisitions of land. The criticism that it gives wealthy companies the opportunity to acquire and hold large acreages is the result of a non-understanding of the situation.

The matter of assessment work has aroused a storm of criticism; why, it is difficult to understand. The revised law does not take from the prospector the right he has at present to perform his annual assessment work if he chooses. Moreover, it does give him the privilege, now non-existent, of paying the assessment work in cash in lieu of this labor; money which does not go into a general fund but must be expended for the benefit of the district in which his claims lie. It may be spent in developing roads that will greatly benefit any subsequent work which he will do or for many other purposes that will be much more to his benefit than digging a hole in the loosest wash he can find on his claim. There is only one possible class of mining-camp men who can suffer under this clause, and that class is composed of those men, common to so many districts, who will undertake to contract the assessment work on a group of claims at $25 per claim and render a receipt for a record in the office of the mining district for $100 worth of work done per claim.

The revised mining law does not take away from the prospector or any other class any of the rights which they have under the present law. The section providing for vertical boundaries of claims is not retroactive and does not deprive anyone of any extralateral rights now being enjoyed. On the other hand, these vertical boundaries will insure to the holder of a claim any ore within his boundaries that might subsequently be discovered to apex outside of his line and which under the present law would then be taken away from him.

With abolition of the law of the apex, square claims are the natural ones; everybody seems to agree to that. Regarding the size of the claim, there was difference of opinion as to whether the unit should be 10 acres or 40 acres. The committee rather ingeniously provided for both. The people living in the Northwest, who were familiar with the large claims of British Columbia, wanted large claims; the miners operating in the Southwest, who were familiar with the small square claims of Mexico, wanted small claims. By making the 10-acre square claim the unit, the Southwestern miners got what they asked for and the Northwestern miners were satisfied because, by locating a number of these small units, they could get a claim of any size and shape they desired.

Of course there is no logical reason why there should be any difference in the manner of locating placer and lode claims; especially is there no difference when the law of the apex is abolished. The proposed bill does not cover phosphate deposits, petroleum, etc., for the reason that they are reserved under the leasing acts.

At the February meeting of the Mining and Metallurgical Society of America, Congressman Arentz was the guest of honor. He spoke at length and then joined in a round-table discussion of the merits of the bill and the points criticized. As a result a perfect accord seemed to be reached between the Congressman and the members of the revision committee present, and it is confidently expected that the points of irritation in the bill can and will be eliminated so that the very great benefits aimed at, not only for the general public but also for the mining profession, including the prospector, the mining engineer, and the operator, will be achieved.

PERCY E. BARBOUR.

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## The Coal Strike

BY THE time this issue is out the coal strike will be well under way. It is to be hoped that it will not be accompanied by disorders. It is to be hoped, moreover, that efforts toward compromises will not be successful.

This thing must be fought out, and the sooner it is brought to a sharp conclusion the better will it be for everybody, the coal miners, themselves, included. Our industries have got to have cheaper coal. So have the inhabitants of those sections of the country wherein anthracite coal is the chief domestic fuel.

Those misguided persons, carried away by their emotions, who are talking sympathetically in favor of the coal miners, do not appreciate that they are counselling expedients that are contrary to the interests of the American people in general. If the anthracite operators deserve any criticism, it is for the moderation of their proposed reduction of wages. Anthracite coal has got to be furnished to the consuming public at very much lower prices than even the new wage scale will permit.

It is contrary to the public interest to have consummated a contract between operators and miners that will maintain high prices for an indispensable commodity over a term of years, for the benefit of classes of people who are exceedingly few in number in comparison with the whole; not even if such contract results in some abatement of the extravagantly high prices that the consumer has had to pay heretofore.

W. R. INGALLS.

## A Code of Ethics for all Engineers

THE members of the Institute have been requested by a resolution of the Board of Directors to comment on a Code of Ethics. This Code was presented to the Board in February and again in March, and in the meantime was published in the March number of MINING AND METALLURGY. The ethics of the mining engineers stand as high if not higher than those of any other profession; the very nature of mining engineering and the relations of the mining engineer to his client make this not only necessary but natural. The mining engineer's judgment and integrity are worth much more to his client than his ability with a slide rule. The mining world is comparatively small and while mistakes in judgment may be forgiven, lapses from the narrow path of rectitude never are. However, it is proper to promote the ethics of the engineering profession at large by coöperation in formulating a code for general adoption. Careful scrutiny of the proposed code is urged and criticisms are solicited. The resolutions adopted by the Board are as follows:

WHEREAS, a Joint Committee of Engineering Societies has submitted a Code of Ethics for Engineers and asks its adoption by the governing bodies of the four Founder Societies, and

WHEREAS, the said Code of Ethics has been published in the March number of MINING AND METALLURGY, the official organ of this Institute,

BE IT RESOLVED: That the Board of Directors of the A. I. M. E., while agreeing in principle with the Code as proposed, believes that it should not be definitely adopted by the Board without giving the membership at large a full opportunity to discuss the subject, and propose possible modifications which might adapt the Code to the special conditions of the mining profession, and

RESOLVED, that a copy of this action of the Board of Directors be published in the April issue of MINING AND METALLURGY, with the request that members send their comments to the Secretary of the Institute.

Although several of the national societies have codes of ethics of long standing and the Institute has never adopted one, the Institute is the only one of the national societies to have expelled members for unprofessional conduct.

PERCY E. BARBOUR.

## Division of Petroleum Technology

AT THE March meeting, the Directors of the Institute authorized the formation of a division within the Institute to be known as the Division of Petroleum Technology. It is hoped that the formation of this division will serve to bring the members of the Institute who are interested primarily in oil and gas into a more compact group and thus promote more effective action by them on their various problems.

In choosing petroleum technology as their especial province, it is the intention of the oil and gas group to occupy a field not at present occupied and to do everything possible to advance more effective methods for the production and utilization of oil.

For the purpose of this division, the term technology is construed in its broadest possible significance, so as to cover the production, transportation, refining and utilization of petroleum and its products, and will include, as heretofore, geology, the technology of drilling and production methods, transportation, refining, fuel utilization and a broad study of possible sources of petroleum.

The present Petroleum and Gas Committee of the Institute has been authorized by the directors to take the steps necessary for the formation of such a division.

E. DEGOLYER.

## Patent Office Relief Bill

OWING to an unfortunate inadvertence in the printing office, the word "patent" in the title of the short editorial on this subject in the March magazine was made to read "patient." One of our members has written to us about it, asking if it was *mal à propos* or malice *propos*. It was accidental, however *propos*.

We are informed that the entire force of 1016 employees of the Patent Office, who certainly have been "patient" during the long period of neglect and lack of appreciation, are jubilant over the long-sought recognition and that the resulting increased morale is already making for a more efficient and expeditious handling of the public business.

PERCY E. BARBOUR.

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# Review of the Month

DURING the month of March there was some lifting of the veil, revealing somewhat of the maelstrom in the economics and politics of the world. Great Britain was in throes of political controversy, with threats of resignation by Lloyd George and a general election to ensue. Ireland was uneasy with internecine squabbles. The leaders of the opposing sides have been summoned to London for a conference which Parliament believes offers the only hope of a solution of the present difficulties.

France, awakening more and more to grim realities, learned of a budget for 1922 calling for more than 50 billion francs, or nearly one-third of the estimated national production, with the prospect that after this deduction is made there will be nothing left over what is required for the immediate support of the people, and that on a reduced scale.

Germany, although hard at work, found itself coming closer and closer to financial collapse and repeated its intimations that it would be unable to keep up with the provisional payments of 31 million gold marks to the Reparations Commission every 10 days as arranged at Cannes.

Russia suffered more acutely from the famine and there were evidences of political insubordination among the Ukrainians.

Egypt was in trouble arising from determination to win independence. About the middle of March the complete independence of Egypt was established and that country passed into somewhat the same relationship toward Great Britain that Panama has to the United States.

At the head of the Adriatic, Fiume came into notice again with disorders threatening to produce conflict between Italy and Jugoslavia.

In the Near East there were forebodings of trouble through resumption this spring of the war between Greece and Turkey.

The Government of India informed the British Government that the intensity of feeling of the Moslems of India would make advisable revision of the Sèvres treaty between Turkey and the Allies. It urged evacuation of Constantinople and the restoration of the sovereignty of the Sultan over the holy places and the reestablishment of the Turk in Thrace, Adrianople and Smyrna. The publication of this report by Mr. Montagu, Secretary of State for India, on his own responsibility led to his expulsion from the ministry. Following this, orders were issued for the arrest of Gandhi, the leader of the agitation in India. That was effected on March 10 and he was sentenced to six years imprisonment.

All over the world, there were labor troubles. In Australia the long contest between employers and workmen seemed to be coming to a head. In Italy there were riots between the Fascisti and Socialist elements. At Genoa the labor unions declared a general strike. In Spain labor troubles began to brew, owing to the movement toward wage reductions that were necessary to enable Spain to maintain its export trade. In South Africa the miners' strike in the Transvaal, which at the end of February appeared to have been conquered, broke out with increased intensity, attended with violence, and threatened to involve the entire Commonwealth. About March 10 there were armed conflicts in the Transvaal and things looked very much like a rebellion against the Government. After a pitched battle the insurrection was put down and the strike came to an end.

Economically, every country of the civilized world, with the sole exception of Germany, is characterized by a high percentage of unemployment. With that situation there can be no prosperity, for there can not be adequate production, nor normality of trade, if large percentages of the people be idle; nor can there be while the several governments maintain profligacy in their expenditures. In the United States the strike in the textile industry of New England has spread and the coal miners' unions of several of the states voted to strike on April 1. By the time this page is printed a general coal miners' strike will doubtless have begun.

The overshadowing political event in the United States was the introduction of the soldier bonus bill in a particularly deceptive and vicious form. It was passed by the House by an overwhelming majority.

Another important event was the declaration that the United States would not participate in the Genoa Conference, although intention to hold aloof from European economic affairs was disclaimed. We may discern in this an American diplomatic policy of enforcing military economies in France; and by refusing to talk with Lenin and Trotzky, while professing friendship for the Russian people, to contribute to the development of political changes in Russia. Good opinion as to Russian affairs is to the effect that the Bolshevists are on their last legs and are playing desperate cards.

The American troops were ordered home from Germany and Secretary Hughes demanded of the Entente recognition of the American claim for the cost of having maintained these troops on the Rhine.

The Senate finally ratified the Four-Power treaty insuring peace in the Pacific.

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# Prospecting and Research*

By ARTHUR S. DWIGHT

President, American Institute of Mining and Metallurgical Engineers

WE DO NOT have to go so very far back, when measured in actual years, to what may be considered the beginning of the industrial era of the great West, the discovery of gold in California in 1848, just 74 years ago. By a strange coincidence, this event occurred within a few days of the signing of the treaty with Mexico which ceded California to the United States. Needless to describe the mighty wave of humanity that hurled itself toward the setting sun in response to that call. The single thought in every one's mind was *gold*. The gold as they found it in placers or ledges could be so easily worked, and the product was so readily transportable, and available immediately as money, that practically no attention was paid to deposits of the base metals, in the treatment of which cheap transportation was a paramount consideration; consequently little progress was made in anything but gold mining until after the Civil War.

The next great step was accomplished when East and West were united by the successful construction of the Union Pacific Railroad from Omaha across the great plains and through the Rockies to meet the rails of the Central Pacific coming eastward across the Sierras. The industrial history of our great West really dates from the day when those two bands of steel were joined, on the shores of the Great Salt Lake at Promontory Point, May 10, 1869. That seems a long time ago when we think of the enormous changes that have been wrought since that day, and when we regard the rich empire that has sprung up in that western land.

Into the new empire thus made accessible, by this first thread of steam transportation, flocked a new brood of adventurous spirits from the older communities of the East.

This way walked Fate; and as she went, flung far the line of destiny,
That bound an untracked continent to brotherhood from sea to sea;
That long gray trail of dream and hope, marked mile by mile with graves that keep
On every barren hill and slope some stout heart lost in dreamless sleep.
Patience and faith and fortitude were willed to it and justified;
Stern, homely virtues, plain and rude, eternal as the sky and wide.
Nor ever sea-king dared the sea in sterner mood than these who went
Strong armed to wrest from Mystery their birthright, half a continent.

* Inaugural address at Banquet, Feb. 22, 1922.

And so the prospectors multiplied. They swarmed over the hills, still searching for gold by preference, but taking more and more notice of other metals, especially as transportation became easier. With every discovery a mushroom city would spring up almost over night, perhaps to be abandoned to the coyotes and rattlesnakes when the next mad rush followed a new discovery elsewhere. It was a great drama, this breaking of the trails and the winning of the West. The prospector is the hero of the play.

T. A. Rickard has put the emphasis in the right place when he says:

> The fur trader traversed the snow-clad plains and penetrated the pine-clad mountains of the Canadian Northwest; the salmon fisher sailed into the long estuaries; but neither of them touched the heart of that great lone land. Not until the pick of the miner awoke echoes that had slumbered since creation did the vast solitude respond to pulsations of human endeavor. Hunters, traders, even soldiers and farmers crossed the prairies from the Mississippi to the Rocky Mountains, and adventured over the desert to the Pacific Coast. They carried the flag, and they hoisted it over the new dominion, but it was an empty conquest and a vain annexation until the miner spoke the word that set the world aflame.

As the ores of lead and copper containing the precious metals came to be mined, only the richer ones that could stand transportation to distant smelteries in the East or to the refineries of Europe were shipped, but the bulk of the mineral wealth that was thus uncovered had to await the establishment of smelting plants near at hand. The 80's and 90's witnessed a great development of the smelting industry, especially in Colorado, Utah and Montana, and the men trained in that school of metallurgy have shaped the practice of the whole world in non-ferrous metallurgy since that day. The low rates for smelting which resulted from the keen business competition for ores, coupled with very low freight rates, developed an enormous metal output in the Rocky Mountain region, and acted as strong encouragement to continued prospecting. Mexico also was only awaiting the coming of railroads and smelting plants to yield up her mineral treasures.

In all of this impressive development, it was the prospector who, with tireless activity in the eager search for new districts, kept the mining industry supplied with new material and opportunity for profitable exploitation.

It was notoriously thankless work. Seldom did the prospector, even though lucky enough to "strike it rich," reap the final reward that his indomitable

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courage, self sacrifice and self-imposed hardships should have entitled him to receive.

As "the blood of the martyrs was the seed of the Church," so the unrequited toil and hard fate of the prospector was the cornerstone of the mining industry, and his work constituted a fundamentally important stage in the growth and maintenance of the business. Into that stage was concentrated an incredible amount of non-productive labor and wastage, waste of human hopes, waste of human lives. No money could buy such effort; no hireling would have endured it; none but an enthusiast, a dreamer, could have stood the pace.

It was almost invariably the man with the money, who came later, the capitalist, whether an obscure shopkeeper in a mining camp, furnishing the grub-stake, or the dealer in millions who supplied the business talent and the capital necessary to develop the discovery into a profitable enterprise, a going concern, who claimed the credit and reaped the reward.

### Rosy Romance of Prospector

But rough and obscure as was the prospector, a rosy cloud of romance has always hung over him as he is popularly portrayed. He is classed with the heroes of poetry and history, with Jason's Argonauts in search of the Golden Fleece, with Hercules seeking the golden fruit of the Hesperides, with Marco Polo, Columbus, Magellan and the other dauntless spirits who opened up the world to our use. Certainly he has many points in common with them, but especially his ever-present hope of a rich reward to be won by his individual courage and striving.

But the old breed has disappeared into the limbo of the past, along with the red man and the buffalo; vanished before the very tide of civilization and progress of which he was the forerunner, and indeed which he himself evoked. His epitaph might be fittingly written in another aphorism by the author just quoted: "Trade follows the flag, but the flag follows the pick."

I shall not attempt to further eulogize the prospector. That has been done by lips more eloquent than mine, but rather, after acknowledging the great debt that the mining industry owes to him, to brush aside for a moment the mists of romance, and see some of the serious consequences to the industry of his passing.

We have heard many discussions of late concerning the decline of the mining industry, its whys and wherefors. I shall, of course, ignore the temporary commercial conditions that have caused the present industrial stagnation, for I am contemplating only certain phases of the general underlying conditions.

While there are doubtless many factors that could be named as contributory causes for this decline, such as exhaustion of certain mining districts, high wages, scarcity of labor, unwise mining and land laws, restrictive legislation, and others, the principal cause undoubtedly is that we have not been replenishing our mineral reserves by the discovery of new mines and districts as fast as we have exhausted the old. We have been "burning the candle at both ends;" though the inevitable consequences have been considerably delayed, and the situation somewhat mitigated by the progress that has been concurrently made in the methods of ore treatment, whereby ores of lower and lower grade could be treated at a profit. Each generation of metallurgists has been able to work over the mine dumps that were rejected by their predecessors, and the end is not yet; but the metallurgist has outstripped the miner, and with present facilities there is a serious dearth in mineral supplies.

The outcome is bound to be as inevitable as the laws of logic can make it. The prospector set in motion forces far beyond his ken, and these forces were to gather momentum and sweep him from their track. He had created a machine that outgrew his power to control, and he must needs step aside. The restraints of the civilization that grew up around him were too onerous for his free, untrammelled nature, and on the other hand, civilization had no patience with such an example of hopeless inefficiency. Hemmed in on all sides by the expanding boundaries of prosperous communities, with his beloved hills and forests appropriated as forest reservations, subject to perplexing rules and regulations, placarded with advertisements of patent medicines or improved breakfast foods, he felt that the very air of the mountains had been preëmpted, and he fled, we know not where. Thus, the very conditions that made for perfection in the industry furnished also the microbe of decay. With our efficiency engineers and our campaigns for the elimination of waste in the industry, we have indeed succeeded in producing cheaper metals, but we have at the same time eliminated the most wasteful single factor, though the most necessary, of the whole industry, the prospector. That is what is the matter with mining!

### Research in Broadest Sense the Remedy

What is the remedy? My answer briefly is *Research*, research considered in its broadest sense. Not the ordinary conception of hiring a young chemist to make a few analyses, though that may be a very useful thing to do, but the awakening of a general spirit of research, the habit of mind that does not take things for granted simply because *they are*, but that cultivates the power of observation and correlates facts old and new under the direction of imagination tempered by ripe technical experience. Imagination alone is a dangerous guide, but as an ally to sound judgment it is unconquerable. Napoleon said "Imagination rules the world." We of the mining profession need to develop more generally the trick of constructive imagination.

A witty person has said that Boston is not merely a city; *it is a state of mind.* If we could develop a state of mind conducive to research in this sense, the whole mining industry would be pervaded with a lifegiving

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atmosphere, and a renaissance of creative effort would be sure to result.

Turning now to the practical side of the question, it is evident that we cannot any longer depend upon the knight-errant prospector to keep us supplied with new mines. We know that the surface indications have been everywhere in this country so closely scrutinized that there is decreasing likelihood of new discoveries at grass-roots, but any mining man looking back on his own experience must realize that many an abandoned prospect he has seen was the victim of ignorance, bad observation, lack of courage, or of financial means. There are undoubtedly many such prospects that would amply repay further exploration and intelligent consideration. Deep exploration from existing mines will also develop new ore supplies.

In general, however, we may say that the situation is a serious one, and we must look to the inventor for the remedy. He must find us new means for conducting our prospecting, and improved methods of ore treatment.

In what I am about to say, please do not understand that I would overlook for a moment any of the present standard methods of ore discovery in favor of something untried or fanciful. In the last analysis, the most potent talismans are the faithful old pick and shovel.

Neither would I scrap the old methods of ore treatment; quite the contrary. Simplicity is a cardinal virtue that should not be lost sight of either by the miner or the metallurgist, and I would seek for inspiration by going back to a study of the older and simpler processes, and see if by a comparative criticism in the light of modern technical knowledge, their weak points could not be strengthened, their strong points reinforced and their causes of failure removed.

### Latent Possibilities in Materials

As a matter of fact, we have at our command an enormous store of latent possibilities in the way of new materials of construction, fuels, refractories, new substances capable of an infinity of chemical reactions, properties of matter and elemental forces formerly unknown, and means for accurate measurement and control of conditions, the importance of which we do not begin yet to adequately comprehend. Every single new discovery along these lines opens up entirely new fields of possibilities for improvement of old methods or the creation of new.

What we need is first a knowledge of the facts; second, the intellectual vision to see its application to the practical problem; third, sound critical judgment, capable of discriminating between the foolish and the useful; and finally, the patience and courage to put the idea through to a commercial success.

It is not only along mechanical lines that we need stimulation. We must look to the geologist to shape his studies more and more toward the practical requirements of the miner, and to change his rôle from that of historian after the fact to that of prophet and leader. He must find a way to tell us the nature of the hidden orebody and its relative richness by reading the handwriting of Mother Nature that he finds in the weathered rocks of the outcrop, or the neighboring rocks of the deeper workings, so that the miner may confidently follow his indications. He must discover the Rosetta Stone that will furnish the key to interpret these hieroglyphics of the Earth Gods.

Then again, the inventor may find us a way to locate hidden ore by enlisting the aid of some of those mysterious agencies that are now at our command, strange vibratory things, like the genii of the Arabian Nights, that can penetrate cosmic space or terrestrial substance with swift purpose, and which are being made to increase a million-fold the delicacy of the five human senses. It sounds fanciful, the idea of seeing into the ground, or perhaps listening to the whisperings of the rocks, or reading the message of the earth currents, but we must admit that stranger things have happened in our own time.

### Present Possibilities in Metallurgy

In the field of metallurgy the possibilities are still more evident. The research work that is now being done, and there is a good deal of it, is concerning itself principally with the products rather than with what may be called the grand problems of metallurgy. There is a crying demand from the trade for improving the quality of the metallic products, eliminating impurities, forming new alloys with special properties, but established industry is instinctively conservative when it comes to anything that might threaten the value of existing plant investment; it is inclined to let well enough alone, and let the other fellow do the experimenting if he wants to. The thought of fundamental changes in process or apparatus, therefore, is not always a welcome one, and comparatively little encouragement is offered for this kind of research on the larger working scale necessary for the convincing demonstration of any new process. This is natural enough, but does not make for progress. One trouble is that the manager is seldom the owner, and if he has the vision, he seldom has the power to make any sweeping change, even though he might be thoroughly convinced that his company would make money by scrapping the old plant. All these questions depend in the last analysis on the human factor, for a skilful metallurgist will produce better results with a tumbledown out-of-date plant than his less resourceful neighbor may with all the modern improvements.

There are some notable exceptions to this general neglect of research, and the names of several large companies that are already carrying out a broad-minded policy in this respect will instantly occur to you. It is

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a notable fact that in the plants of these companies there is to be observed the zeal for research in all departments, from the furnacemen to the manager, and it is safe to say it extends to the stockholders also, whose consent is a necessary factor. When the stockholder becomes convinced that his future dividends depend on the encouragement of research, just as the life of a mine depends on spending a certain proportion of earnings on development work, we shall find this atmosphere a prevalent one. Meantime, the engineer can do much to advance that time by his individual efforts, and by proving that it is worth while financially.

It is pertinent at this point to mention the excellent research work that is being done by the U. S. Bureau of Mines at its various experimental stations. The Bureau has published some valuable studies in special metallurgical methods. Just how far these results have been utilized, I cannot say, but they ought to be of great benefit in suggesting opportunities for further effective research by individuals to meet special problems. I venture the opinion, however, that it is much like all the other aids that come too easily and are not appreciated.

### Industrial Progress and Individual Striving

Prof. Elihu Thompson has truly said: "Publish an invention freely, and it will almost surely die from lack of interest in its development. It will not be developed and the world will not be benefitted." This leads up directly to the main point I wish to make. Industrial progress is gained only by individual striving. It is a long shot from an idea, however good, or a paper patent, however well drawn, to a going success, and few who have not been through the mill can appreciate these words. Almost every epoch-making invention was pronounced a failure at first, and it is only the unconquerable enthusiasm of the inventor, and his steadfast ability to meet the financial and moral strain, that saves the idea to the industry.

If the world is to profit by this fine constructive spirit, we must take our lesson from the prospector, and appeal to the same instinct that led him in his tireless search for gold. Call it greed, if you will, but it is a noble form of greed, for it seeks not to profit by taking that which is another's, but by creating new benefits to man, and making two blades of grass grow where one, or perhaps none grew before. The possibility of riches is one of the greatest incentives that can touch and animate the human mind, and inspire human endeavor. No hireling will do what a man will do who is to profit directly by his own efforts in proportion to his success.

Even the soulless corporation is amenable to the same urge, for it is hope of greater gain that dictates its course. It is wise indeed if it clearly recognizes the continuity of this principle and the importance of this trait of human nature by offering to its employees well defined rewards for successful ideas. It will be still wiser if it enlarges its corps of helpers and offers adequate inducement to independent workers on the outside to furnish solutions to certain definite problems. Put a premium on ideas, and they will be forthcoming. The fact that the incompetent and the over-enthusiastic might take advantage of such an open-minded attitude should not militate against the principle. One always has the right of choice, and can say "no" to a wild-eyed inventor as easily as he can turn down a mining prospect. Commercial success should be the final arbiter in all cases.

Wise patent legislation is an important factor in such a plan, but actual accomplishment and beneficial use should always be allowed to outweigh the sterile, unused idea which lies dormant in the patent office until some one comes along who has wit enough to make the idea effective. The patent office is filled to suffocation with such half-baked ideas which are worse than useless because they simply obstruct progress by causing litigation.

We have had some recent instances of large corporations possessed of important holdings of ore, with great potential value in metals but not amenable to ordinary methods of extraction, courageously attacking their special problems and, by following these very principles, working out satisfactory solutions. I might mention the electrolytic zinc process at Anaconda, the leaching of the copper ores of the New Cornelia company in Arizona, and the copper-leaching problem at Chuquicamata, Chile, as outstanding examples of well-directed team work.

So I believe it is possible to solve many of the pressing problems that confront our mining and metallurgical industry by first diagnosing those problems clearly and then holding out adequate rewards for successful solution, at the same time surrounding the industry with such conditions as will encourage and not hamper the free exercise of the inventive faculty. Thus shall we eliminate, as far as possible, the wastage and cruel disappointment that was so often the lot of the pioneer prospector, and we shall retain and foster the vital element that was his glory; his strivings, his patient courage and his fine contempt for privation and danger.

Necessity is not the mother of invention, any more than she was the patron saint of the prospector. The Prospector and the Inventor are twin brothers, and Hope is the mother of both. We take off our hat to the prospector.

Stern school of heroes unconfessed; unweighed for meed of right
or wrong;
By glib late-comers dispossessed of honors that to them belong;
As in the fire tried hour, strange warring elements will fuse
To purpose, unity and power, to truer strength and noble use—
Unconscious, save that here was life a man might live as manhood
meant,
They wrought a nation from their strife, and shaped it with their
discontent.

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# Progress and Literature

By J. R. FINLAY

Consulting Mining Engineer, New York City

THE other day, I fell into conversation with two gentlemen who desired to improve the condition of the people; so that the talk was semi-political. They seemed to agree that I was inclined to be "conservative," "reactionary," perhaps an "evolutionist," looking upon "reform" with suspicion. Finally I rejoined somewhat in this manner:

"You attach to me phrases that I have heard all my life but which convey no meaning to me. It is quite true that I do not make a fetish of terms like reform, liberty, democracy and so forth; neither do I worship the idea that 'things are good enough as they are,' 'leave well enough alone' and so forth. There is more satisfaction in building something up than in tearing something down, or in just maintaining something that is already built. Progress is a popular word; but what is progress? In my opinion it is comprised, so far as public welfare is concerned, of two elements: Improvements in production of goods and knowledge; improvements in keeping order."

This substitute for politics, economics, reform, progress, conservatism, radicalism, democracy, socialism, monarchism and all the phrases of public welfare may seem over-simple; perhaps it is, but at least it defines something. It seems to me to be at least worth attention.

## Artistic and Useful Production

If we define production of "goods and knowledge" as embracing all efforts that are worth anything we cover automatically the range of the human intellect. The painting of a picture or the making of a poem is as truly production as the reaping of wheat or the construction of a table on which to eat the bread that comes from the wheat. A poor picture or poem is to be compared merely to poorly cooked bread or to a commonplace table; they may go under the name of art, but are no more art than bad cooking. The best painting or poem may claim higher artistry than the best cooking; they are more permanent; but if poor cooking gives rise to physical indigestion, so the pretense of art under the name of literature, or anything else, brings on mental indigestion, which is far worse; for the first may give a drowsy spell or a stomach ache to a few people, while the second may give ills to the body politic such as will spoil the happiness of millions. At any rate, it does not seem to require very abstruse analysis to arrive at the conclusion that production is the result of putting the mind to good use, that the most valuable production comes from the best minds; and conversely that the best minds are the most productive—whether we measure production in manufacture of articles, in thought or in imagination.

## Good Government Aids Production

As I drove my automobile in Los Angeles the other day, my small boy asked me how I should like to be a traffic policeman. I answered that I would not like it because I would rather do something more productive; but after some pause I decided to take that statement back quite emphatically. I thought of Mexico and of Russia. The policeman was keeping order; preventing accidents, saving other people the loss of time: not directly productive, but indirectly exceedingly productive. In a country like this, where we have been taking reasonably good order and reasonably good government for granted, we are apt to forget that those are the greatest possible business assets, and the only way we have to remind ourselves of their value is to consider the condition of some country where they are absent. What is property worth in such a country? What reward does one get for his efforts, physical or mental?

Lincoln, on hearing himself called, very likely in compliment, a common looking man, said: "The Lord prefers common looking people; that is why he makes so many of them." The common looking common people of all countries are scantily provided with goods—they can use more; they do not enjoy anxiety; they like to be able to go about without carrying a gun; their personal freedom extends only to the frontier of the realm of order. To melt in an ecstasy over liberty and democracy while one is afraid to say what he believes, to work as he thinks is fitting, or to go out at night as he thinks he ought, does not seem to help a common looking man to get along in the world; and it may be doubted whether those words will give him permanent satisfaction or pleasure.

The mainstay of genuine progress can be nothing less than a great group of men, numbered by millions in any great nation, numerous enough surely to be called common, who are the guardians of common sense; the progenitors, recognizers and followers and choosers of sound leadership, who distinguish substance from show, logic from vaporing; who realize that to support and improve prosperity and order includes the development of all the capacity of the human brain.

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It seems to me that a great society of technical men like the American Institute of Mining and Metallurgical Engineers represents to a fair extent leadership among such plain people of this most productive country. This is not intended for flattery or for hyperbole, but for a plain statement of the plain truth. I am sure its members have used their influence for the development of genuine productiveness; for the extension of fair play and good order such as make prosperity possible. We may properly be anxious that they shall continue to use their influence in the same direction, not by expressing cut-and-dried, arbitrary, narrow or intolerant opinions, however sincere or well meant, but by deepening and widening if possible the foundation for sound thinking and respect for the truth. It strikes me occasionally with a sort of alarm that for two or three generations we have been taking our government and order for granted; that our conception of the fundamentals that underlie them may have wilted; that the country is not so safe as it once was against gusts of hysteria, vagaries and artificial prejudices; that, in short, in a few generations more we may come in for a period of disorder and civil war.

Some people complain that the Institute TRANSACTIONS are a jargon of technicalities, uninspired, materialistic, built upon an imagination restricted to efficiency and accuracy, unresponsive to sentiment and taste, measured in dollars and cents. If this is not true we should have an intelligent answer for the charge; if it is true we should try to correct it. I am inclined to think that we have put too much faith in technology and too little in human interests. In order to picture how far we may have wandered in one direction, let me quote some sentences from George Bernard Shaw's "Back to Methuselah" which will make it plain how far some people have wandered in another:

> But meanwhile—and here comes the horror of it—our technical instruction is honest and efficient. The public school boy who is carefully blinded, duped and corrupted as to the nature of a society based on profiteering, and is taught to honor parasitic idleness and luxury, learns to ride and shoot and keep fit with all the assistance and guidance that can be procured for him by the most anxiously sincere desire that he may do these things well, and if possible superlatively well. . . . The result is that powers of destruction that could hardly without uneasiness be entrusted to infinite wisdom and infinite benevolence are placed in the hands of romantic schoolboy patriots who, however generous by nature, are by education ignoramuses, dupes, snobs and sportsmen to whom fighting is a religion and killing an accomplishment; . . . financial parasites on the money market, and merely stupid conservators of everything that exists merely because they are used to it, is obtained by heredity, by simple purchase, by keeping newspapers and pretending that they are organs of public opinion, by the wiles of seductive women, and by prostituting ambitious talent to the service of the profiteers, who call the tune because, having secured all the spare plunder, they alone can afford to pay the piper.

Really, I do not know whether this tirade is intended to be taken seriously or not. My impression is that it is deadly serious but spoken in the manner of jest. I call attention to it mainly because it is an example of literature, from the fountain head, that lives on phrases that represent half thoughts and whole prejudices. Papers, magazines and books are full of them: profiteer, militarist, parasitic idleness and luxury, imperialists, financial parasites, stupid conservators, seductive women, prostituting ambitious talent, spare plunder—all occur in one sentence. Similar phrases occur elsewhere in a whole type or style of literature: radical, capitalism, socialism, pacifism, industrialism, Mohammedan, Catholic, Protestant—simply words that come to be accepted as banners of allegiance or as objects of loathing and denunciation. To repeat them is to sound the tocsin of prejudice, for or against. At present they seem almost harmless, although they were far from harmless during the war; but let one look through history to see how seriously such phrases have been taken and how, over the chimeras that they represent, prosperity has been ruined by cycles of civil discord.

## International Geological Congress

THE 13th International Geological Congress will meet at Brussels, Belgium, Aug. 10–19, 1922. Any person interested may take part in the meetings and in the excursions during the days of the Congress, irrespective of professional qualifications. There will be excursions of special geological interest from Aug. 1 to 9, and from Aug. 21 to Sept. 3, but these are limited to professional geologists, geographers, mining engineers and others interested in the study of one or another branch of geology.

The official language of the Congress will be French, but papers and communications in English are admissible. Anyone who wishes to offer a paper or who desires information regarding the Congress is requested to write to the General Secretary at the Service Géologique de Belgique, Palais du Cinquantenaire, Brussels.

The Committee of Organization has decided not to admit applications to take part from nationals of those countries lately at war, in defiance of treaty obligations, with Belgium.

## Spontaneous Ignition of Coal in Storage

THIS subject is well summarized by J. F. Springer in *Combustion* for February. Anthracite coal is practically immune from spontaneous ignition. Bituminous coal under certain conditions of storage gives a great deal of trouble. Factors promoting self-ignition are:

1. Fineness; a slack coal presents greater surface for oxidation and also ignites more readily.

2. Depth of storage pile; as the dispersion of heat is retarded by deep piles. A depth of 20 ft. is unsafe, while no trouble is to be expected in piles less than 12 ft. deep.

Submergence of stored coal under water is the usual method of preventing ignition.

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# Blue Powder in Zinc Smelting

By W. R. INGALLS
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SOME months ago, I had occasion to make an investigation that introduced the subject of blue powder that is produced as a byproduct in zinc distillation. Although every zinc smelter is aware that more or less blue powder production is inevitable and there is a common practice as regards the treatment of it, the specific and quantitative data respecting the subject were more imperfect than would have been expected. I had reports from eight important works. Some of the data were especially determined for my investigation.

Speaking generally, there is a good deal of uniformity in the figures, all of which show that the blue powder product bears a large proportion to the ore originally charged into the retorts; that a large proportion of the retort capacity is devoted to the redistillation of blue powder; and that of the spelter product of a furnace about 30 per cent. is derived from blue powder, *i.e.*, it is zinc that has been distilled twice. The figures from the works are given in the following table:

| | Per Cent. Retort Capacity Devoted to Blue Powder | Per Cent. Spelter Made from Blue Powder | Per Cent. Blue Powder to Ore | Assay of Blue Powder Per Cent. Zn |
|---|---|---|---|---|
| A. | 22¼ | 32 | | |
| B. | | | 35 | 51 |
| C. | 23⅓ | 30 | | |
| D. | | 30 | | 62½ |
| E. | | 24½ | | |
| F. | | 33⅓ | 50 | |

In American zinc smelting terminology, blue powder is different from what it is in the European. In Europe blue powder is finely divided metallic zinc, more or less oxidized, which is collected in the prolongs. This is blue powder, strictly speaking. It is formed in relatively small quantity and is of relatively high grade in zinc.

In America it is the ordinary practice to throw in one pile the blue powder coming from the ladle skimmings, together with the retort samplings, condenser scrapings, condenser chips, and floor sweepings. This produces a large weight of material of low grade in zinc on the average.

I judged from the correspondence that many smelters have not given critical attention to this subject. One smelter (works G) caused a furnace determination to be made, with the results shown in the second table.

In this case, byproducts that have to be rehandled amount in weight to about 50 per cent. of the weight of the ore (19,000 lb. charged into the retorts). This appears to be an unusually high proportion and that is reflected in the low average in zinc of these byproducts, which is only 21.67 per cent. In the treatment of an ore charge assaying 72 per cent. zinc, the extraction of metal is 12,450 lb., whereof 1850 lb. may be estimated as coming from the byproducts and 10,600 lb. from the ore, *i.e.*, about 85 per cent. of the spelter came directly from ore. These are rather superior figures from the angle of metal extraction. The main drawback in this

| Ladle Skimmings | Pounds | Per Cent. ZnO | Per Cent. Metallic Zn | Per Cent. Lead |
|---|---|---|---|---|
| 1st draw | 1,165 | 42.30 | 34.0 | 0.49 |
| 2nd draw | 1,138 | 47.15 | 29.6 | 0.61 |
| 3rd draw | 1,002 | 43.66 | 25.8 | 0.99 |
| Condenser cleanings and floor sweepings | 826 | 26.75 | 32.10 | 0.87 |
| Condenser chips | 843 | 27.68 | 14.25 | 0.32 |
| Retort samplings | 4,378 | 30.29 | 14.85 | 0.61 |
| *Total* | 9,352 | | | |
| Ore charge | 19,000 | Assay 72 per cent. Zn. | | |

case is the large quantity of material that has to be rehandled. The ladle skimmings alone amount to about 17½ per cent. of the weight of the ore charge.

Another smelter (works H) reported the following:

In the regular operation of a natural gas furnace and most producer gas furnaces, the byproducts are not weighed and even if they are weighed the information is of little or no value for checking up the operation. The reason for this is that it is an easy matter for a workman to get the necessary amount of products without getting the material that is desired. The weights were obtained in the regular operation at one of the plants but even with this it will be necessary to give more or less general information as there is so much variation. On the same class of ore, however, the amount of metal that is recovered from the byproducts is rather uniform, after the method of firing the furnace, for best results, is established.

For a high-grade roasted ore containing about 70 per cent. zinc the following would be close to representative results:

Ladle skimmings, 19 per cent. of weight of ore, contents 80 per cent. zinc.

Retort samples, 9 per cent. of weight of ore, contents 35 per cent. zinc.

Condenser chips, 3 per cent. of weight of ore, contents 45 per cent. zinc.

Total byproducts, 31 per cent. of weight of ore, contents 27 per cent. zinc.

The above figures represent the byproducts from the ore plus the byproducts from retreating the original byproducts. This is the condition as it exists from day to day in the operation.

With very low-grade complex ores, the zinc contents of the byproducts is often as high as 45 per cent. of the contents of the original ore. This means that the metal recovered directly from ore to spelter is very low on these ores.

The ladle skimmings contain about 60 per cent. zinc as metallic and about 20 per cent. zinc as oxide. The lead in the ladle skimmings varies greatly, but as a general thing contains about 70 per cent. as much lead as the ore treated. If an ore is smelted which contains 10 per cent. lead, then the skimmings would contain about 7 per cent. lead.

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The retort samples are much lower in lead than the skimmings, for all of the luting material goes into this product. The average is probably about 40 per cent. of the average of the ore. This product increases in lead, however, if the ore is poorly roasted. In this case there is an accumulation of lead sulfide in the mouth of the retort which is removed with the sample product.

In the above case the ladle skimmings amount to 19 per cent. of the weight of the ore charged, compared with about 17½ per cent. in works G, and their assay in zinc is very much higher. On the other hand, the amount of retort samplings is very much less. This indicates that the first of these smelters made a practice of removing a good deal more of the rich material from around the mouth of the retort. In works H, out of a total spelter production of 12,600 lb. about 3600 lb. were derived from blue powder, leaving about 9000 lb. as coming directly from the ore, wherefore about 28½ per cent. of the spelter came from the second distillation.

Improvements in methods for the minimizing of the quantity of these byproducts and for the retreatment of those that will be made inevitably is obviously a subject that deserves very careful consideration. At the present time an amount of material approximately equivalent to one-third of the ore originally charged must be rehandled and retreated, not only at direct expense, but also at the cost of the use of a corresponding amount of furnace capacity. Furthermore, about 30 per cent. of the zinc in the original ore is subjected to loss in distillation a second time, which loss in terms of percentage is undoubtedly as large as the loss in the first distillation.

In European zinc smelting practice the quantities and assays of the blue powder and other byproducts are decidedly different from the American. In one plant, excellently managed, which commonly works on a roasted blende containing 49 per cent. Zn, from which an extraction of 85 to 86 per cent. in the form of spelter is made, typical figures are the following:

| | Per Cent. of Ore Charged | Assay in Zinc Per Cent. |
|---|---|---|
| Sweeps from drawing | 15.24 | 56 |
| Condenser chips, etc | 3.77 | 60 |
| Blue powder | 3.96 | 83 |
| Total | 22.97 | |

Computation of the above figures shows that 100 lb. of ore yields about 23 lb. of byproducts containing about 14 lb. of zinc. Inasmuch as 100 lb. of ore yields finally about 42 lb. of zinc the quantity that goes first into the byproducts is about one-third of what ultimately is produced as spelter. This is not very different from American figures, but the quantity of the byproducts is less than we make, on the whole. Moreover, it is to be considered that the grade of the ore distilled in this works is lower than what we treat. It is well known that the percentage of byproducts decreases as the ore increases in grade. Thus, in treating ore of 51 per cent. grade in the same works, ladle sweeps fell to 10.33 per cent., condenser chips to 2.73 per cent. and blue powder to 2.74, a total of 15.8 per cent.

In these works the sweeps is what is obtained from the condenser and ladle in drawing. The old condensers are not only chipped, but after chipping they are crushed and concentrated over Wilfley tables. The blue powder is what is obtained from the prolongs. American zinc smelters do not use prolongs. Consequently the blue powder obtained from them and also the condenser concentrates are over and above what we get in American practice.

Considering all of these things, the European zinc distilling practice is better than the American in the matter of byproducts. This is attributable in large measure to the European type of furnace front, with the condensers enclosed in deep closets, and to the custom of drawing spelter only once in 24 hr. In works that use a small amount of salt, both in the ore charge and in skimming the ladle, there is relatively little zinc as metallics in the ladle skimmings, which is ascribed to the effect of the salt.

In reworking the byproducts some European smelters put everything in with the ore charge, but some deem it advantageous to treat them separately in a special furnace which can be operated differently from those treating an ore charge alone. The works from which I have cited figures has a plant of furnaces that are uniform in size. Five-sixths of their number are kept on ore charges and one-sixth on byproduct charges.

I am simply giving some facts in this contribution without offering any criticisms regarding any practice or expressing any opinion as to the comparative merits of American and European. Conditions are likely to determine one line of procedure in one place and another line in another place and obviously there can not be any useful analysis without a previous examination of the conditions in each case. My suggestion is limited to drawing attention to the importance of the subject.

## Eyesight Conservation in Industry

IN A careful examination of 10,000 industrial and commercial workers, active in their work and supposedly in good condition, 53 per cent. showed defective vision uncorrected. According to a booklet entitled "Eye Sight Conservation," which has been issued by the Eye Sight Conservation Council of America, employees often are accused of inefficiency and carelessness when it is entirely a matter of imperfect vision. This booklet, a part of the study of Waste in Industry conducted by the Federated American Engineering Societies, and also other literature on the subject, may be obtained from the Eye Sight Conservation Council, Times Building, New York.

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# Civil Engineers' Attitude Toward Licensing Engineers*

By JOHN M. GOODELL
Civil Engineer, Montclair, N. J.

CIVIL engineers seem to number in their ranks more advocates of licensing than are found among the practitioners of other branches of the profession. Licensing was not originated by civil engineers but it was forced upon them in two ways.

In the first place, the civil engineering profession has hangers-on like every other profession. The first legislative result of their imperfect accomplishments with which I am familiar occurred in the far West. It was found that early irrigation works were so badly planned in some cases that not only were water rights made very uncertain but considerable sums were invested in structures and ditches which proved inadequate and occasionally complete failures. Water was too valuable to be wasted in that way and money too hard to obtain. In those sections, therefore, laws were passed many years ago which made it obligatory for the design of irrigation works and other structures utilizing water to be made by engineers who had satisfied a board of examiners that they possessed the technical qualifications to plan such works properly.

The basic thought on which such laws rest is the same as that on which laws governing the licensing of boiler operators rest, namely, the safety and welfare of the public. While boiler explosions still occur and irrigation works are built which are not wholly satisfactory, these laws have helped the public, it is generally agreed.

## Licensing Forced on Civil Engineers

Licensing has been forced on civil engineers in another way. A good many years ago, architects in a few sections of the country found so much unsafe and wasteful building going on under the direction of manifestly incompetent men calling themselves architects that they decided to advocate the licensing of architects. This was done first in Illinois nearly 20 years ago. The early laws were unsatisfactory to the architects and later legislation passed at their earnest solicitation was so stringent in preventing the construction of buildings from the plans of anybody who did not hold an architect's license that the engineers who made a specialty of structural engineering and the mechanical engineers who had hitherto designed the smaller structures needed in their work suddenly found themselves barred from continuing such designing. It was necessary, therefore, for the engineers to secure the passage of a law that would permit them to carry on their work after duly proving their competence in the same way that the architects were examined. This rather restricted branch of engineering, related to architecture, is made a very real danger to the civil engineering fraternity if it does not coöperate with architects who are seeking to have a law passed requiring the licensing of architects.

## Engineering Already Controlled by Law

The licensing of engineers must be considered from another viewpoint. There is no branch of the engineering profession more controlled by welfare and sumptuary laws. The architectural engineer is subject in many cities to building codes. Where there is a code and its provisions are intelligently and carefully enforced, I believe that the welfare of the public is better safeguarded than by any form of license legislation that has been proposed. Unfortunately, building codes, no matter how good, are rarely enforced and still more rarely do they apply except in large cities. Consequently there are many civil engineers who are inclined to believe that it is idle to expect real protection of the public against incompetent architectural engineering and bad contracting work through the adoption of building codes.

Again, sanitary engineers practicing in many states find that their work is controlled by regulations of the State Board of Health. In many states, any new water supply and any new sewerage system cannot be undertaken until the engineers of the State Board of Health have approved the plans. For instance, in New York and Ohio, all proposed works have their plans criticized minutely. In New Jersey, even the sizes of sewers are prescribed by regulation. In fact, sanitary engineering is so controlled by existing legislation of this kind in some states that licensing engineers cannot improve the conditions from the viewpoint of public health; but in other states, where the State Board of Health confines its attention mainly to strictly medical subjects, a great deal of sanitary engineering is being done that is very poor from an engineering point of view, and in

* Address at meeting of New York Local Section, Jan. 11, 1922.

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some cases cannot be approved from the viewpoint of public health. There is a feeling among some civil engineers, therefore, that even the sanitary branch of the profession should be licensed in order to protect the public of some states against ignorance and bad judgment.

There is still another section of civil engineering work where some civil engineers believe that licensing laws may be helpful. Construction work often calls for the design of large structures, trestles, railways, falsework, reservoirs, power plants and the like. Sometimes the design of these structures used for construction purposes is more difficult than the design of the finished works themselves. Accidents due to a collapse of a bridge during construction may cost many lives. At present there is practically no legislation safeguarding workmen during construction except workmen's compensation laws. There is a feeling among some civil engineers that, if laws can be passed and properly enforced that will make it certain that temporary structures shall be designed and built only by competent men, such legislation is desirable.

### Licensing Considered Utopian

All of the arguments for licensing engineers which I have outlined are based on the assumption that it is practicable to examine engineers, register them intelligently and give them licenses that will prevent the man in the street from engaging an incompetent man for his work. The greater number of the civil engineers in responsible charge of work feel that such legislation is Utopian. It is undoubtedly their opinion that the best license law that can be written, administered with the greatest diligence and intelligence possible, can do so little toward safeguarding the public that the effort is not worth while. These men, however, are inclined to stand behind, or at least to try to guide, the movement for licensing engineers for just one reason—expediency. They feel that on account of the situation governing architectural engineering, to which I have referred, and because of the very active work carried on by a few engineers representing all branches of the profession, they must favor laws that will be fair, for otherwise unfair and unworkable legislation is probable.

I have endeavored to state the opinion of responsible civil engineers, so far as I am acquainted with it. I know of but two prominent civil engineers who believe that licensing will do any good to the profession or to the public. Unfortunately, we must also consider the opinions of engineers not in positions of responsibility, but who aspire to places of that kind and particularly to places of larger compensation without greater responsibility. There is not much danger of bad judgment on the part of the educated, ambitious, hardworking man who holds such views, which are perfectly natural, but we all realize that the man who is not particularly fitted for civil engineering responsibilities and has grown into a chronic grumbler makes a great deal of trouble at times. In the civil engineering field such men are lined up to a man behind license legislation, not because they can give any good argument for it but because they hope that somewhere from its mysterious folds it may shed a little manna into their nerveless hands. This class of engineers, who are waiting for the public to find out their merits and doing nothing to warrant attention from the public, still less its support, is far-flung and old, and years ago wearied Kipling, then a young Anglo-Indian journalist, into writing the following poem, which is inserted here as indicating the effect of the equivalent of pleas for licensing upon an intelligent young mind willing to win its own place in public esteem by hard work and study:

Study of an Elevation in Indian Ink

This ditty is a string of lies,
But—how the deuce did Gubbins rise?

Potiphar Gubbins, C. E.,
Stands at the top of the tree;
And I muse in my bed on the reasons that led
To the hoisting of Potiphar G.

Potiphar Gubbins, C. E.,
Is seven years junior to me;
Each bridge that he makes either buckles or breaks,
And his work is as rough as he.

Potiphar Gubbins, C. E.,
Is coarse as a chimpanzee;
And I can't understand why you gave him your hand,
Lovely Mehitable Lee.

Potiphar Gubbins, C. E.,
Is dear to the Powers that Be;
For they bow and they smile in an affable style
Which is seldom accorded to Me.

Potiphar Gubbins, C. E.,
Is certain as certain can be
Of a highly paid post which is claimed by a host
Of seniors—including Me.

Careless and lazy is he,
Greatly inferior to Me;
What is the spell that you manage so well,
Commonplace Potiphar G.?

Lovely Mehitable Lee,
Let me inquire of thee,
Should I have riz to where Potiphar is
Hadst thou been mated to Me?

We civil engineers believe that in view of the many laws governing the licensing of engineers which are now on the statute books, few of which have been administered long enough to give any information concerning their utility to the public or to the profession, it is desirable to exert every resource toward preventing the further passage of such laws until there has been time for more experience with those now on the statute books. I can see no reasonable defense for any more of this experimental legislation, under the claim that it is for the benefit of the safety, health and welfare of the public. Any such claim is jeopardizing the reputation of engineering for accuracy in large and small things.

Take the law of Virginia, for example, which merely says that an engineer or architect shall not call himself

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a Registered Engineer or Registered Architect unless he has been licensed to do so. If he does not care to be licensed he can still offer to practice as an engineer or architect, just as he has always done. Largely through the activity of a member of the mining profession, a license law was passed lately in Arizona. Under it a barber, out of a job, can design and build a building of any kind or a power house or a dam, provided he does not claim to be an architect or an engineer.

At the other end of the long legislation scale, so full of inharmonious notes, there is the remarkable law passed last year in the state of New Jersey, so bad that no attempt has been made to administer it, so far as I can learn. An attempt was made to put a similar bill through the New York legislature about the same time, but the latter was defeated. This law, if enforced, will apparently make it illegal for the Babcock & Wilcox Co. to send one of its chemical experts from the laboratory at Bayonne to the boiler plant of any customer in the neighborhood to see what is causing, say, the pitting of the drums of a boiler bought from this company. Public welfare and business efficiency are served better than in any other way if the company's specialist in such work makes this visit and gives his advice on the case after discussing the observed facts with his associates. The company is interested, of course, in having its boilers give the very best possible service and its representative will do every thing he can to see that this service is given. On the other hand, the additional information gathered from this investigation will go to swell the total mass of information on this subject available to the company's customers throughout the country. Under this New Jersey law, it will be illegal, apparently, for an engineer of the Public Service Electric Co. to visit the plant of a consumer where trouble is being experienced with the electrical equipment of that plant. It will be illegal, apparently, for one of the engineers of the Hackensack Water Co. to talk over with an architect designing a large apartment house the proper size for the service pipes and risers.

### Undesirability of Trying to Enforce Ethics by Law

Two opinions which have been developed by a number of civil engineers who have given a large amount of attention to engineering licensing through a good many months deserve attention:

1. It is undesirable to attempt to enforce a code of ethics by means of a law requiring the licensing of engineers. As a rule, an engineering code of ethics is drawn in vague terms and is usually more applicable to those engaged in consulting work than to the greatly more numerous salaried engineers. No code proposed in the United States has been universally adopted. The time is not ripe, therefore, to word a license law, nominally passed for the public safety, health and welfare, so that it will compel every registered engineer to be a subscriber to a code of engineering ethics. That would be class legislation, which the courts will not support.

2. In the civil engineering field, most engineers work as members of organizations rather than as individuals. Even small civil engineering operations are usually best handled by a group of engineers, working with one responsible head, of course, but having an average higher responsibility than is the case in the mechanical and electrical branches with which I am familiar. Most civil engineers, in fact, do not care for individual practice of a professional nature. Some of these men associate themselves in partnerships but in recent years a constantly increasing number become associated in an incorporated manner. They are all trying to build up the reputation of the partnership or the company. That reputation is good will; it is a real asset. It is represented to the public by the firm or company name. If the owner of a silk mill in Paterson wishes to enlarge its boiler plant, he and his engineer may desire to go to the Babcock & Wilcox Co. at Bayonne for consultation about the best method of carrying out their plans, although both Mr. Babcock and Mr. Wilcox have been dead these many years. This is one case of engineering service which unwise license laws render it difficult to give.

A company was formed to carry on the work of a well known member of the American Society of Mechanical Engineers who died recently. Taking active part in the work, there are engineers, accountants, economists and a lawyer. In order to safeguard the interests of the widow of this engineer, these gentlemen asked a young banker to join with them in incorporating a company to carry on this very useful and successful practice in the best possible manner. It is being conducted by the same organization and in the same way as before the death of the founder, but in order that all interested in it may share in proper proportion its responsibilities and rewards, the organization is now that of an incorporated company. This is a desirable method of conducting the practice from every point of view, yet some forms of proposed license laws would make it illegal.

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## Haywood Offers an Opportunity in Russia

ACCORDING to a press dispatch from Moscow, March 14, William D. Haywood heads a group of American I. W. W. men to whom Premier Lenin has granted a concession to operate the Nadezhdinsky iron works in the Urals, part of the coal mines in the Kusnetz basin, and auxiliary factories. It is stipulated that 4800 fully qualified American workers, with a technical personnel, shall be brought into Russia to operate the properties, and that each of them must purchase $100 worth of tools or instruments for his own equipment and sign an undertaking to observe all the rules of the Soviet labor code.

The announcement states that the Government has assigned $300,000 towards financing the undertaking. It is also to provide wood to build homes for workers and assign 27,000 acres of land for agriculture. The American workmen are to be organized into a trade union association.

The whole production of all these concessions is to go to the Government, which undertakes to supply the workmen with a ration and allow them part of the production as necessary means to carry on further work.

The agreement is to hold for two years. If the workmen desire to leave Russia earlier, the Government is to assist them to return to their country, after they have handed over to the state the works and factories, together with the tools, etc. brought from abroad.

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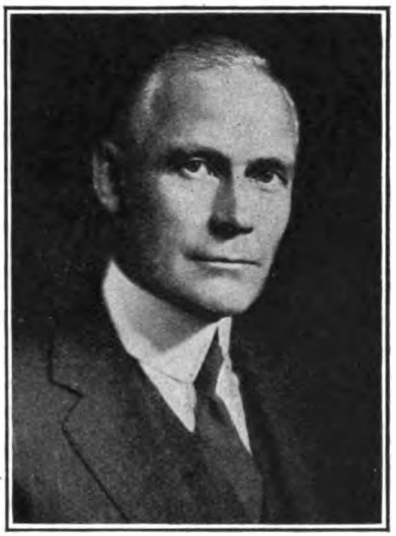

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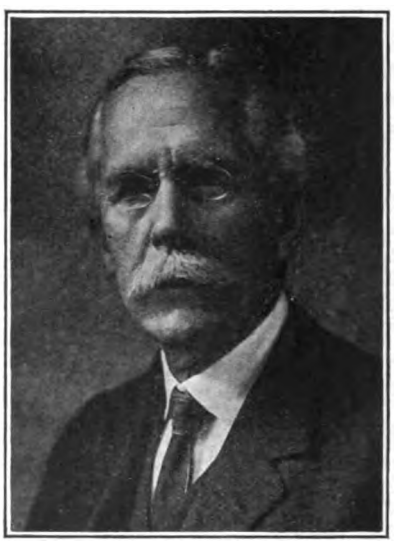

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# Potash Reserves in West Texas*

By DAVID WHITE

Chief Geologist, U. S. Geological Survey

THE search for potash salts in the great "Red Beds" region of the Southwest, conducted for several years by the U. S. Geological Survey, the work being carried on for a part of the time in coöperation with the Bureau of Economic Geology and Technology of the University of Texas, has resulted in the discovery, within shafting depth, of potash salts, apparently of workable thickness and commercial quality, and probably of great extent. Definite information is lacking as to the exact thickness of the potash beds, the size and boundaries of the areas underlain by workable strata, and the locations of the deposits richest and most favorably situated for exploitation.

Briefly to review the salient features of the general situation: We have in the great Red Beds region of the southwestern United States, embracing portions of central Kansas, western Oklahoma, eastern New Mexico, and northern and western Texas, a series of sandstones, shales, anhydrite beds, clays and limestones, which, through an interval of 1000 ft., more or less, carry beds of salt, estimated by Darton[1] to contain over 30,000 billions of tons of rock salt. It is the greatest known salt field of the world. At some points the intercalated beds of rock salt, one of which is reported by the driller to exceed 300 ft. in thickness, aggregate, according to the drillers' records, over 1000 ft. The sedimentary strata are similar in composition to those carrying the potash deposits of western Europe, and they were laid down at the same time and under conditions which, in many respects at least, were similar. The stratigraphy and character of the beds are described by Darton[2] and a part of the area and the reported aggregate thicknesses of salt are shown, with some revision after Darton, in the accompanying map, Fig. 1.

The assumption that in the great areas of shallow evaporation basins spread over the vast base-level region of saline deposition in the Southwest during Permo-Triassic time, potash salts were in some places, and at different stages, thrown down in crystalline deposits associated with the beds of rock salt, anhydrite, and gypsum, is, geologically speaking, more than reasonable. They are to be expected, and the conviction that they are probably present has long been held both in the Texas Bureau of Economic Geology and Technology, under Dr. J. A. Udden, and in the U. S. Geological Survey. Accordingly, for many years, efforts to determine whether potash deposits are present in this region have been made, though under very great difficulties, such as insufficient funds for boring, lack of drilling on private initiative in the more promising regions, lack of interest at first on the part of the drillers and companies, and, later, inadequacy both of the methods of boring and of the sampling, to reveal in definite terms the thickness of any saline stratum of given composition.

## First Discovery of Potash

Traces, or small showings of potash in Texas, were first discovered in 1912 by J. A. Udden[3] in the 4489-ft. hole at Spur, in Dickens County (No. 1 on map), where a brine from about 2200 ft. was found, after standing, to contain 5.4 per cent. potassium calculated as chloride. In 1915, crystals of red salt were found in material coming from between 875 and 925 ft. in the well at Boden, in western Potter County (No. 2 on map). This salt, probably polyhalite, assayed 9.2 per cent. $K_2O$.

The Miller well, bored in 1915, in western Randall County (No. 3 on map), furnished some red salt from somewhere between 1500 and 1700 ft. in depth, that contained 6.1 per cent. $K_2O$, and, at an undetermined level below 1700 ft., yielded some colorless salt particles containing 10.5 per cent. of $K_2O$.[4] The two localities last named are in the Pan-handle of Texas.

Later, in 1920 and 1921, as a result of slightly more effective watching, favored by occasional wildcatting for oil farther toward the Staked Plains, potash in the form of polyhalite ($MgSO_4 + K_2SO_4 + 2CaSO_4 + 2H_2O$), was found by the joint coöperative field agents in drill cuttings at several widely separated localities in west Texas, as follows:

1. Among some material incompletely representing irregular intervals in the Bryant well, bored by the States Oil Corpn., 9 miles south of Midland, in Midland County (No. 4 on map), were found bailings, after boring from 2405 to 2411 ft., a sample of which con-

* Published by permission of the Director of the U. S. Geological Survey.

[1] N. H. Darton: Permian Salt Deposits of the South-central United States: U. S. Geol. Survey *Bull.* 715 (1921) 205–230. The entire salt-bearing region is shown in Mr. Darton's map.

[2] *Op. cit.*, 205.

[3] J. A. Udden: The Deep Boring at Spur. Univ. of Texas *Bull.* 363 (1914) 82–90.

[4] J. A. Udden: Potash in the Texas Permian. Tex. Univ. *Bull.* 17 (1915) 51.

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tained 8.94 per cent. $K_2O$ in the soluble salts. The driller reported the same material to the depth of 2425 ft., but in the publication of the analysis the interval covered by the sample is erroneously given as 2405 to 2425.

2. About the same time, in the spring of 1921, cuttings bailed after boring from 1864 to 1865 ft. in the Burns well, of the La Mesa Oil Co., on the Burns ranch, 16 miles east of La Mesa, in Dawson County (No. 5 on map), were found to contain 10.82 per cent. of $K_2O$. Allowing for hangover bailings, this part of the well must be largely in polyhalite.

3. As yet the efforts to induce the companies and drillers to incur the trouble and consequent cost necessary to more frequent and careful collection of samples has been only partly successful. However, when the River well was drilled by the A. Pitts Oil Co., on the Pecos River, 8 miles east of Barstow, in Ward County (No. 6 on map), more samples were taken, though the available log kept by the driller is fragmentary and utterly inadequate. The more important results of the tests of these samples are shown in Table 1.

TABLE 1.—*Samples of Well Drillig nfrom Well of A Pitts Oil Co.**

| Depth, Feet | $K_2O$ in Sample, Per Cent. | Soluble Salts (1 Gram:100 cc. $H_2O$) | $K_2O$ in Soluble Salts, Per Cent. |
|---|---|---|---|
| 1405 | 1.68 | 87.80 | 1.91 |
| 1445–1530 | 0.74 | 87.34 | 0.85 |
| 1600–1610 | 9.03 | 62.74 | 14.40 |
| 1610–1614 | 5.60 | 66.54 | 8.42 |
| 1620–1625 | 0.77 | 93.54 | 0.82 |
| 1625–1636 | 0.48 | 94.70 | 0.51 |
| 1645 | 4.23 | 40.32 | 10.50 |
| 1660 | 0.59 | 89.64 | 0.66 |
| 1695–1700 | 6.29 | 55.42 | 11.35 |
| 1700–1704 | 2.49 | 43.46 | 5.74 |
| 1760–1770 | 0.39 | 93.44 | 0.42 |
| 1770–1780 | 0.29 | 98.10 | 0.30 |
| 1780–1785 | 0.31 | 88.34 | 0.35 |
| 1785 | 0.25 | 21.42 | 1.17 |
| 1800–1804 | 0.13 | 33.08 | 0.39 |

*8 Miles East of Barstow, Ward County, Texas, Located on Sec. 25, Blk. 33.

This well, like the others, was drilled for oil. At the depth of 2275 ft. not all the salts could have been penetrated. Crusts and lumps of polyhalite were found in the sump by the field observer. Two of these, on analysis, proved to be pure polyhalite. The salts in the pit at the time the samples were found came from the intervals between the 1000 and 1500-ft. levels. One specimen weighed slightly more than an ounce, had a fine crystalline structure, and was of a dark brick red color. The other specimen, about the same size, had a much finer texture, similar to that of the polyhalite found at Stassfurt; the color was a light red to salmon. This specimen was perfectly uniform in composition, no inclusions of any sort being visible, the surfaces showing perfectly clean fractures, and to all appearances it had been chipped from a much larger mass.

It is interesting to note, in the analyses made by George Steiger, and given in Table 2, that neither specimen contained chlorides. For comparison, analysis of a gray polyhalite from Stassfurt and the theoretical composite of polyhalite are given.

TABLE 2.—*Analysis of Two Samples of Well Drillings Compared with Two Other Analyses*

| | Red | Salmon | Stassfurt | Theoretical |
|---|---|---|---|---|
| Insoluble in water.. | 0.27 | 0.39 | 0.47 | |
| CaO | 18.75 | 18.54 | 18.42 | 18.6 |
| MgO | 6.48 | 6.16 | 6.52 | 6.6 |
| $K_2O$ | 15.66 | 15.37 | 15.36 | 15.6 |
| $Mn_2O$ | None | 0.20 | 0.09 | |
| $SO_3$ | 52.40 | 52.60 | 52.68 | 53.2 |
| $H_2O-$ | | 0.05 | | |
| $H_2O+$ | 6.07 | 6.45 | 6.43 | 6.0 |
| $NH_4$ | None | None | | |
| Cs | | None | | |
| Rb | | None | | |
| Cl | None | None | | |
| $B_2O_3$ | None | None | | |
| $CO_2$ | None | None | | |
| $NO_3$ | | None | | |
| F | None | None | | |
| | | 99.76 | 99.97 | 100.0 |

From the meager evidence at hand, it is evident that polyhalite was laid down at four or more levels in the Pitts well. It is much to be regretted that cuttings were not gathered at every 5 ft., and, still more, that cores were not cut through the saline deposits in order that indispensably necessary facts as to the thickness and purity of the polyhalite beds themselves might have been obtained when the well was drilled.

4. Information far more exact and satisfactory in character has lately been obtained at the Means No. 1 well, drilled for oil by the Pinal Dome Oil Corpn. in northeastern Loving County, Texas, a short distance west-southwest of the southeast corner of New Mexico (No. 7 on map). Fortunately, this well was bailed at every 5 ft. between 535 ft. and 4030 ft. and samples of the bailings were taken. All these have been subjected to rough tests for potash, with supplementary assays in the chemical laboratory of the U. S. Geological Survey of the samples that showed notable values in potash. These samples, which will be discussed later, reveal the presence of a dozen levels between the depth of 930 ft. and 2350 ft., at which potash occurs in unusual amounts. Five of these levels, or stages, contain salts notably high in potassium in deposits with indicated thicknesses of several feet.

5. The McDowell well, No. 4, in northern Glasscock County, next to be considered, would appear to be near the southeast margin of the main region of salt deposition and, as will be noted on the map (No. 8), is reported by the driller to have only about 190 ft. of rock salt in the aggregate through a distance of 2610 ft. The sampling of this well, which is close to oil produc-

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tion, is imperfect, but there seem to be seven zones that show small amounts of potash. However, the sample from the bailings after drilling from a depth of 1035 to 1050 (15 ft.) was found, by analysis, to contain 10.67 per cent. of $K_2O$, or 15.22 per cent. of the matter soluble, 1 gm. of sample to 100 cc. of water. Allowing for "hangover" bailings from above, this locality is notable.

6. To complete the record, mention may be made of the presence of 22.9 per cent. of $K_2O$ reported in the soluble salts in a sample *selected* from the cuttings from between 1070 and 1075 ft., and of 17.68 per cent., according to the analysis, of $K_2O$ in similarly selected specimens from cuttings from 1075 to 1083 ft. in the G. A. Jones well on the Long ranch, 16 miles east of Gail, Borden County (No. 8 on map). A picked sample from bailings at 1115 ft. in this well showed 6.59 per cent. $K_2O$ in the soluble salts.

It should be explained that the assay method employed requires a quantity of water for the treatment of 1 gm. of salt capable of dissolving but 0.208 gm. of the 0.450 gm. of $CaSO_4$ contained in 1 gm. of polyhalite. By a simple calculation it will be noted that soluble salts from pure polyhalite will contain about 22.5 per cent. of $K_2O$. The sample referred to above as containing 22.9 per cent. of $K_2O$ evidently was pure polyhalite.

The Means well (No. 6 on map), in Loving County, Texas, may not lie in that part of the basin containing the thickest or richest deposits of potash in this great Red Beds region, but it furnishes the most complete and relatively succinct data obtained up to the present moment as to the vertical range and thickness of the potash zones at any point. Cable tools were used. In Fig. 2 is plotted a part of the log of the well, as reported by the driller, and opposite is shown the potash content of most of the systematic series of samples from the 5-ft. bailings, each in its relative position; *i.e.*, the graph of the $K_2O$ assay of the sample of the bailing brought out after drilling 5 ft. is opposite the same 5-ft. portion of the columnar section representing the well log. The hollow block shows the percentage of potash in the sample as taken from the bailing. The line drawn at the level of 15.6 per cent. indicates the amount of $K_2O$ that should be present if the sample were composed entirely of pure polyhalite. The solid block shows the percentage of $K_2O$ in that part of the sample that is soluble when 1 gm. of the latter is placed in 100 cc. of water.

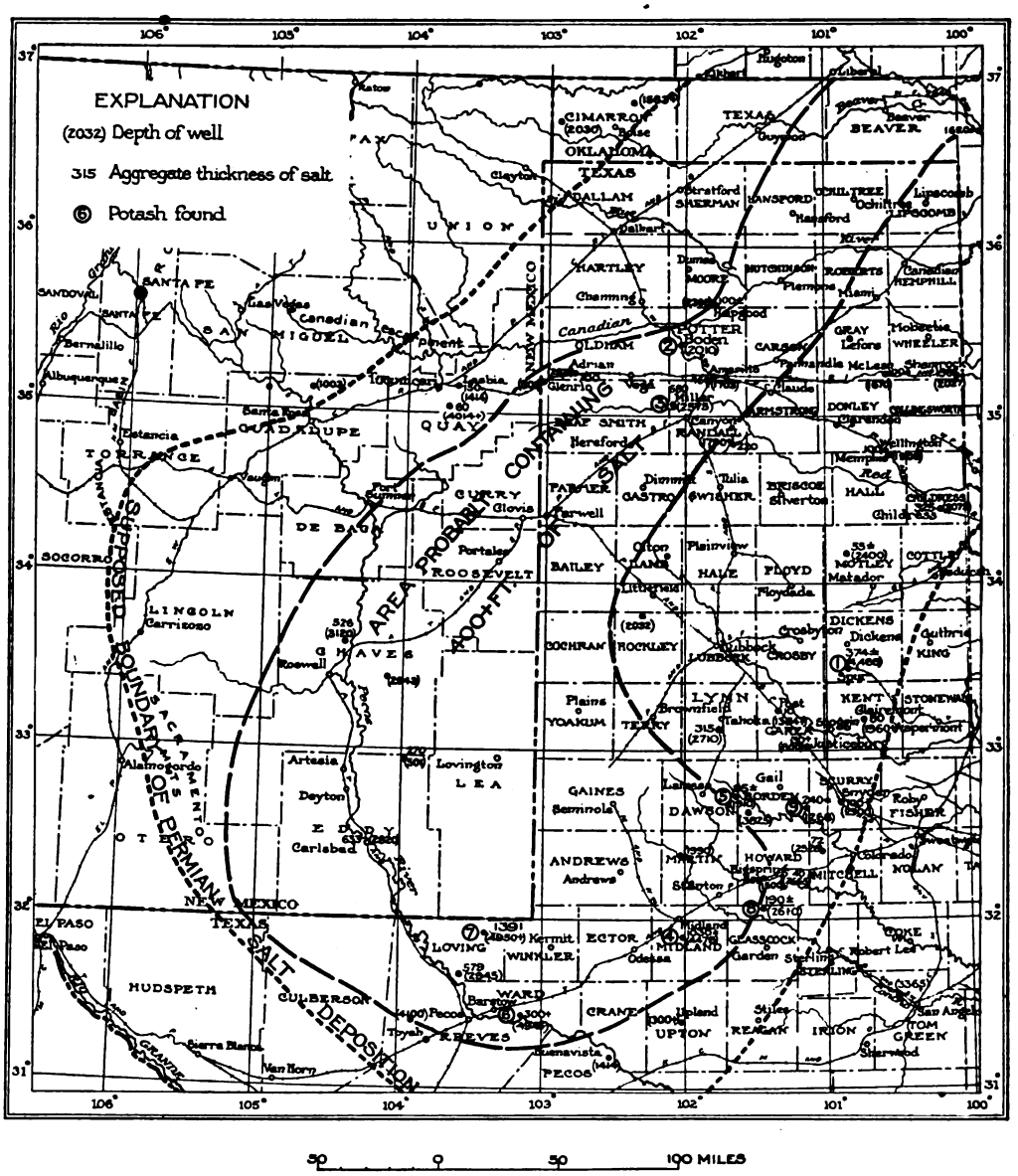


FIG. 1.—PART OF RED BEDS SALT REGION, TEXAS AND NEW MEXICO.

The graph of the potash assays of the 5-ft. cuttings from the Means well deserves study. It is evident that the bailings from the 5 ft. between the depths of 990 and 995 ft. in the well consist mostly of polyhalite. These cuttings were probably—almost certainly, in fact—diluted by rock remaining from the cuttings from the lean strata above, and some of this overhang may have been bailed at 1000 ft., where the cuttings, 995 to 1000 ft. show nearly 4 per cent. $K_2O$. We may infer, from the relative proportions of $K_2O$ in the raw

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samples and in the soluble salts in the cuttings between 1235 and 1260 ft., that rock salt is intercalated; so in the zones 1575 to 1600, 1620 to 1645, and 1690 to 1700 ft. Considerable polyhalite is present with salt in the interval 1735 to 1750 ft.; but it is evident that the salts soluble, 1 gm. of rock in 100 cc. of water, in the cuttings 1815 to 1830 ft., are largely polyhalite, which, as in the interval 1735 to 1750, must compose about one-half of the cuttings brought up by the bailer. It is interesting to note the large percentage of $K_2O$ in the soluble salts between 2000 and 2010 ft. of depth in the well. The fact that this interval is recorded by the drilled as "anhydrite, etc.," though the top 5 ft. is perhaps nearly one-third polyhalite, suggests a thought as to the interpretation of the logs of other wells for the guidance of those searching for potash. Apparently the soluble salt supposed to be found between 935 and 940 ft. is likewise mostly polyhalite, though relatively small in amount.

### Value of Sample Affected in Various Ways

The exact positions and thicknesses of the polyhalite beds passed through in the Means well are debatable subjects on which drillers as well as geologists probably disagree. It seems reasonable, however, to conclude that the drill entered the potash salt very close to 990 ft., and that some hangover rock stuff from above has in effect adulterated the bailings taken from the well after drilling from 990 to 995 ft. The drill probably passed the potash bed before reaching 1000 ft. The potash bailed at the 1005-ft. level may have fallen down or, possibly, hung over from the two previous "screws." The deposits represented in the 995-ft. cuttings may be of workable thickness. The cuttings between 1820 and 1830 ft., which probably may be safely regarded as more than half polyhalite, evidently contain some salt. Probably the grade of the material between 1815 and 1820 ft. is better than indicated in the chart, since much hangover rock of low grade is presumably present.

Only those familiar with the operation of the cable drill can understand fully the possible extent to which material caving into the hole, or remaining in the hole through repeated bailings, may affect the value of the sample and so demand consideration in the interpretation of the log and samples representing any particular interval. Chemists as well as drillers may judge as to the possible exaggerations or disproportions in the assays of the solid matter in the bailings caused by the solution of the more soluble salts. This is likely to affect the results to a critical extent. This aspect of the Texas examinations has very recently been set forth clearly by George Steiger,[5] chief chemist of the U. S. Geological Survey, as follows:

> Oil being the objective and not the soluble salts, no record was kept, so far as known in the Geological Survey, of the quantity of water in the wells or the length of time it may have been in contact with the salts. Neither are any data available concerning casing used, consequently no conclusions could be drawn regarding the possible contamination due to material falling in from higher levels, and only a vague guess could be made as to what extent the potash content of the samples assayed may have been changed by the action of water. Also, it is not known whether the entire amount of material supposed to have come from the section in question had been carefully sampled or a grab-sample taken from a single bailerful.
>
> The samples as received were in fragments approximating in size cracked corn. Had water played the part of dissolving the more soluble salts, the remaining fragments would be expected to show certain characteristics. Fragments of salt only partly dissolved would probably be found with rounded edges. On the other hand, sharp edges on angular fragments might be accounted for by assuming the presence of water in volume sufficiently large to dissolve quickly all salts, including polyhalite, shortly after being torn loose by the drill.
>
> Under the latter condition, a sample would represent material through which the drill had passed immediately before bailing. Many of the samples examined contained well-rounded grains of sodium chloride, and, as might be expected, the angular structure of the fragments of polyhalite and anhydrite had been more perfectly preserved.

Only cuttings and detailed assays of cores can reveal the exact sequence, thickness, and purity of the potash beds.

The evidence appears, therefore, on the whole, strongly to indicate that we have in west Texas and probably in southeastern New Mexico workable beds of polyhalite within 1200 ft. of the surface, and extending through considerable areas. It is practically certain that in this region the United States possesses enormous reserves of potash. It remains to be learned, however, how many, how pure, and how thick the deposits may be, not only in districts as yet wholly untested, but also in the areas where, at the present moment, the information is sufficient only to prove the existence of potash, as at the Bryant well and at the localities in the Panhandle.

In Fig. 1, is reproduced, with some revision, a portion of the map compiled by Darton to show the locations of salt deposits reported by the driller, the depth of the wells, and the aggregate thicknesses of salt as logged. On it I have placed, with some revision to conform to recent studies, the boundary of the area probably containing 400 ft. or more of salt in the aggregate, and the supposed boundary of the Permian salt deposits. However, great uncertainty attends the drillers' logs, not only as to polyhalite, which, as we have already seen, may be put down as anhydrite, but even as to salt. As Darton points out, "pink and red rock," "limestone," as anhydrite is sometimes labeled, "lime shells," etc., give scant information. Some of the logs are obviously defective in their record of the salt beds, and many of the holes are not deep enough to have penetrated all the salt layers, a fact which introduces another element of uncertainty in any deduction as to the region of maximum salt deposition.

It has generally been assumed that potash, if present, would be found in the regions of greatest salt deposition. The greatest published thickness of a single salt bed is that of 380 ft. reported by Darton at Hutchinson, Kansas. The Means well, in Loving County, Texas,

[5] Potash Salts of Western Texas: *Chem. & Met. Eng.* (Jan. 25, 1922) **26**, 175-6.

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revealed, according to the interpretation of the cuttings by D. D. Christner, joint coöperative field observer, and, later, by Harold W. Hoots, of the U. S. Geological Survey, three distinct beds, each having a thickness of 250 ft. or more, the uppermost being 291 ft. thick. The greatest aggregate thickness of salt reported by Darton in any well was 700 ft. at Adrian, in Oldham County, Texas, but the total of the salt in the Means well appears to be 1391 ft., the greatest aggregate thickness yet reliably recorded. Salt beds are found in this well at a depth of 990 ft. and at 4474 ft. The well is now at 4950 ft. This illustrates the fact that the recorded thicknesses of salt shown on the map depend, in many cases at least, on the depth of the hole. Potash in notable amounts was not found below 2350 ft. in the Means well, though 3 per cent. of $K_2O$ was discovered in the 5-ft. bailings for 20 ft. above that level.

Notwithstanding the presence of the three very thick beds of rock salt in the Means well, it is not yet conclusively shown, if allowance be made for depth, that this well lies in the area of maximum salt deposition. That the region is, however, one of great saline precipitation is corroboratively indicated by the record of about 1025 ft. of rock salt in the Bryant well, Midland County, Texas, which is 1478 ft. deep, and the log of 634 ft. of aggregate salt beds in the 2820-ft. well at Carlsbad, New Mexico.[6] Presumably more salt will be found at greater depth in the vicinity of this well and in the Toyah-Bell No. 2 well in southeastern Loving County, 24 miles north of Pecos, where 579 ft. of salt was penetrated before the drill stopped at 2945 feet.

If we assume that the greatest number and perhaps the thickest beds of polyhalite were deposited in the region of greatest deposition of salt, we may conclude that, so far as our knowledge goes at the present moment, the greatest reserves of potash in the southwest Red Beds region lie in the southern end of the Staked Plains country of western Texas, and southeastern New Mexico. This assumption appears reasonable, notwithstanding the fact, as reported by Darton, that no important amount of potash was found in the samples from the 2820-ft. well drilled near Carlsbad, N. Mex., in 1913, nor in the 3120-ft. hole drilled 13 miles north-northeast of Roswell. Apparently in agreement with this is the circumstance that, so far as the Geological Survey is informed, no salt seems to have been met in drilling the Walcott No. 1 well, in Martin County, Texas, about 30 miles north of Midland to a depth of 1990 ft. Digressing, it may be mentioned that this well marks a region of potash stock promotion of the most daring type. The seeming absence both of salt and of notable amounts of potash in this well may be explained by post-Permian deformation into synclinal structure, rather than as due to local conditions of deposition not yet discovered. Confirmative evidence on the latter point is much to be desired. Possibly the greatest potash deposition lies in a transverse east-west or crescentic evaporation basin.

On the other hand, it is possible that the thickest deposits of potash salt will not be found in the areas of greatest total aggregate thickness of rock salt, though the greater number of potash zones may be looked for in those areas. The richest potash deposits may have been laid down in areas of relatively complete evaporation where deposition of rock salt was not so great in total aggregate thickness, but was notably heavy in a relatively restricted period and the corresponding portion of the columnar section. The writer expects the best deposits of potash salt to be not only eccentric to the Permian salt-bearing area, but perhaps at one side of the region of actually greatest aggregate thickness of salt. As the case now stands it would appear that the best, meaning the richest and thickest, high-grade deposits, are, fortunately, in the

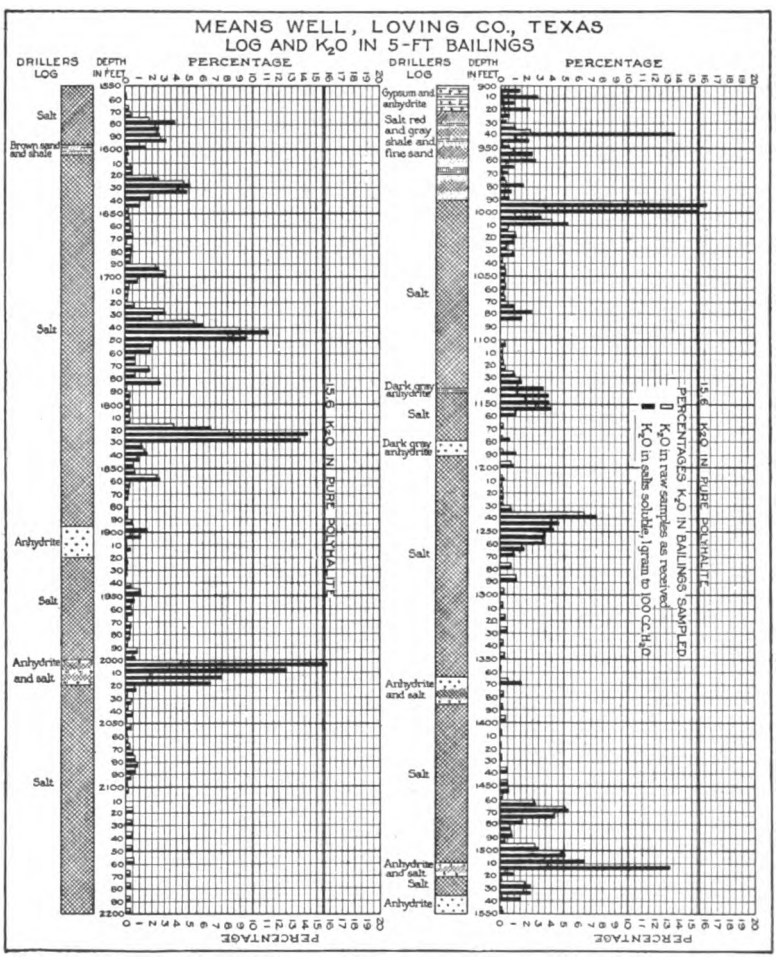
MEANS WELL, LOVING CO., TEXAS
LOG AND $K_2O$ IN 5-FT BAILINGS
DRILLERS LOG
DEPTH IN FEET
PERCENTAGE
Salt
Brown sand and shale
Anhydrite
Anhydrite and salt
15.6 $K_2O$ IN PURE POLYHALITE
Gypsum and anhydrite
Salt red and gray shale and fine sand
Dark gray anhydrite
PERCENTAGES $K_2O$ IN BAILINGS SAMPLED
$K_2O$ in raw samples as received
$K_2O$ in salts soluble 1 gram to 100 CC $H_2O$

FIG. 2.—PART OF THE DRILLER'S LOG OPPOSITE GRAPHS SHOWING POTASH CONTENT OF SAMPLES FROM BAILINGS.

[6] N. H. Darton: *Op. cit.*, 219.

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upper zones of those wells of which we have the most complete knowledge. Deeper drilling, or more thorough sampling, may reverse this tentative deduction. The detailed study of the logs, with correlations of horizons and strata from well to well and from outcrop to outcrop; the determination of the structural conditions obtaining at the times of evaporation of the seas, and the investigation of the physiographic and depositional history of this general region during the Permian and Triassic periods, all of which are essential to the settlement of these questions, are tasks now engaging the attention of Mr. Hoots, whose conclusions should guide the prospector to more intelligent testing for potash in the higher, the middle, or the lower zones.

From the Burns well (No. 5 on map) where 10.82 per cent. of $K_2O$ was found in the soluble salts from bailings after drilling from 1864 to 1865 ft., to the Bryant well (No. 4 on map) where the bailings, after drilling 6 ft., from 2405 to 2411, contained 8.94 per cent. of $K_2O$, is about 65 miles south by west; from the Bryant well to the River well (No. 6 on map), where potash was found at four levels and the test remains incomplete, the distance is 75 miles west-southwest; from the latter well to Means No. 1 (No. 7 on map), is 40 miles north-northwest, and from the Means well to the McDowell well No. 4 (No. 8 on map), in Glasscock County, where 10.67 per cent. of $K_2O$ has been found in bailings after drilling from 1035 to 1050 ft., is about 110 miles due eastward. The polyhalite lumps from the Jones well (No. 9 on map) must not be forgotten.

Remembering the incompleteness of the sampling and the consequently unsatisfactory status of the tests at many of the northern wells, including the Panhandle localities, it is evident that the general area embracing the discoveries of potash is enormous, being in round numbers about 275 miles long and over 125 miles wide. Between Adrian, where Darton records 700 ft. of rock salt in the aggregate and Barstow, Tex., are many counties in Texas and southeastern New Mexico, in which, as indicated on the map, there appear to have been no tests whatever. What may ultimately be found in this great area remains to be seen. In fact, the drillers have taken little interest in potash possibilities and, consistently, in preserving samples of the salines in western Oklahoma, while it can not now be confidently stated that potash is not present in the region of very thick salt deposition in Kansas, as mapped by Darton. At the present moment, however, it seems probable that the most promising region for prospecting for potash lies between the 101 and the 104 meridians, and between the 30°30′ and the 31°30′ parallels, with the indication that the salt beds thin rapidly to the southwest of the Pecos River in this region. This tentative view may be annulled by a carefully conserved set of cuttings from a single well; later exploration may locate the best deposits wholly outside of this area. These undetermined but fundamentally important points, together with such factors as transportation, water supply, and fuel, must be taken into account by him who first undertakes commercial development in west Texas or southeastern New Mexico, lest he make his investment only to find his rival developing more favorably located or far thicker deposits discovered subsequently.

Oil in small amounts has been developed in Loving, Pecos, Reeves, Glasscock, and Mitchell Counties, all within, or adjoining the region of potash prospects, and wildcatting for oil if not for potash is certain to go forward. There is hardly a possible doubt that wells for oil have been drilled through important deposits of potash salt without recognition of the latter on account of the indifference or inertia of the prospector, notwithstanding a possible far greater ultimate value of the potash. A speedy reversal of this attitude will tend to promote the interest of the operator as well as of the public.

### Commercial Possibilities of Products

Polyhalite, consisting of sulfates of potassium, calcium, and magnesium with water ($MgSO_4 + K_2SO_4 + 2CaSO_4 + 2H_2O$) is a low-grade ore of potash but is readily soluble; further, all the sulfates are beneficial to most soils, so that the rock as mined constitutes, in effect, a water-soluble fertilizer containing the equivalent of 15.6 per cent. of potash, $K_2O$, when pure. Such a rock might be used in a raw state for agricultural purposes over a considerable area, the limits of which are fixed by relative costs of mining and transportation. If the beds are as thick as is now indicated inconclusively by the cuttings, we probably have in west Texas deposits capable of supplying a large area of the western cotton region and much of the western beet sugar and fruit-growing country. Obviously, however, it is too early to speculate as to what will be the market radius of simple concentrates or of the more fully refined salts. In studying the commercial possibilities of the deposits, attention should be given not only to the geographic position of the west Texas potash with reference to the great regions of Mid-continent potash consumption and to the Lake, the Atlantic, and the Gulf ports of entry of the richer foreign salts, but also to the geographic and transportation relations of west Texas to the packing plants of Fort Worth, Kansas City, and Memphis; to the phosphates of southwestern Tennessee, and to the potential nitrates of Mussel Shoals.

A more widespread and effective fertilization of the soils of the United States is not merely an agricultural requirement, as is generally acknowledged, it is a national necessity, on which depends the commercial welfare and prosperity of our country in the future. Our position in international trade, and our national financial independence, not to say dominance, can not be sustained indefinitely by the sacrifice of our irreplaceable mineral deposits; a balance of trade in favor of this country can not always be maintained through the sacrifice of our oil, our copper, our sulfur, and other

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mineral heritages in order to make good a deficit met in former years by the export of foodstuffs not needed in our own country.

The present trend of enormous increase in the consuming population which so rapidly swells our cities; of arrested growth of agricultural population and production, and of faltering, if not actually doubtful recuperation of our worn out or rapidly exhausting soils, constitute a menace to this nation of which the disastrous and far-reaching significance is not realized by a public habitually optimistic and blindly complacent. This is the most important economic problem of the United States. Beside it our war debts are trifling and ephemeral. Times have changed and are still changing. Either we must shift our economic basis back to the exportation of replaceable foodstuffs in larger amounts to maintain our trade balance or we must gravitate insensibly into the manufacture of raw materials, imported as well as domestic, on a plane of competition gradually approximating that of the Old World nations. The latter course will inevitably entail not only a continuous stern struggle for commercial prestige and independence, but a sacrifice of our standards of living as well. The productivity of American soils must be restored by every practicable means. Nothing that will lessen the cost of fertilizers or promote their wider and wiser use on our lands can be overlooked or allowed to stand in the way.

The interests of the public demand early and reliable information as to the exact thickness, extent, composition, centers of richness, availability, and possible utilization of the potash deposits in the Southwest. If these questions are not soon solved through private initiative, they should be pushed to adequate conclusion by the state or the federal government. Carefully distributed core drilling is imperatively needed.

## Corrosion Committee

THE National Research Council recently appointed a committee connected with its Division of Research Extension, with the following membership:

W. M. Corse, chairman; National Research Council, Washington D. C.

Colin G. Fink, secretary; 101 Park Avenue, New York, N. Y.

John Johnston, Yale University, New Haven, Conn.

D. M. Buck, American Tin Sheet and Tin Plate Co., Pittsburgh, Pa.

Wilder D. Bancroft, Cornell University, Ithaca, N. Y.

G. K. Burgess, Bureau of Standards, Washington, D. C.

William H. Bassett, American Brass Co., Waterbury, Conn.

E. M. Chamot, Cornell University, Ithaca, N. Y.

This committee is to serve as a general clearing-house and to devote its attention essentially to fundamental scientific study of corrosion. The committee desires to get in touch with the work that is being done on corrosion whether through societies, associations, institutes, universities or private or industrial laboratories.

A statement from Dr. Colin G. Fink, the secretary, says that the corrosion problems have been attacked from two more or less different angles. In one case every effort is being made to arrest the corrosion of the materials now in use; in the second case, new materials are substituted and tried out. There are a series of distinct corrosion problems each centered about some specific material or article of manufacture. For example, there are the problems of the corrosion of food containers and of the corrosion of buried conduits and cables. Besides these specific problems, there are the general investigations on the causes of corrosion under varying conditions and of various materials.

Within the last year decided progress has been made in cutlery steels, in metals and alloys for mine equipment, in cable sheath, in insoluble anodes and in alloys resistant to high temperatures and the corrosive action of molten metals such as zinc, tin, etc., but the corrosion problem, as a whole, in spite of its long past history, is still in its infancy and it is only through coöperative effort and a free discussion of results (those suitable for advertising purposes as well as those usually suppressed) that consistent forward strides are possible.

## International Association of Engineers

THE secretary of Engineering Foundation was the guest of honor at a dinner at the Czechoslovak Legation in Washington, Tuesday evening, Jan. 31, given by the Minister, Dr. B. Stepanek, in appreciation of some helpful services which the Foundation office had been able to perform for the Legation and through it to the engineers and University of Czechoslovakia.

There were present: Doctor Stepanek, his sister Mlle. Stepanek, Ing. Stanislav Spacek, Technical Attaché, Doctor Stangler, Commercial Attaché, Col. John Temple Graves, journalist and orator, James Milholland, journalist, and the following American engineers: Arthur P. Davis, director, U. S. Reclamation Service; Alfred D. Flinn, secretary, Engineering Foundation; George Otis Smith, director, U. S. Geological Survey; Dr. S. W. Stratton, director, U. S. Bureau of Standards; L. W. Wallace, executive secretary, Federated American Engineering Societies.

Doctor Stepanek suggested that the engineers of the world should take a leading part in the world's reconstruction, which cannot be accomplished solely by the men in political life. To be effective, the engineers of the various countries should be brought into relationships through an international association of engineers. Through this association policies could be formulated and agreed upon, information could be exchanged and

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the helpful leadership of the profession constructively exercised in international as well as national movements for the good of mankind.

Doctor Stepanek mentioned the problem of Russia's reconstruction as being chiefly an engineering problem, deserving the most serious consideration of American engineers. He reminded his guests of the friendly bonds between the people of his country (Bohemia) and those of the United States, which are constantly being strengthened. He spoke also of the other fact, that his compatriots, being of Slavic race, were kindred to the Russians and might readily form a useful link for uniting the engineers of America and western Europe with those of Russia. There are 2000 Russian students in Prague.

Strong efforts are being made to transplant to Czechoslovakia (Bohemia) many of the elements of American culture, especially in scientific and technological fields. The engineers of Bohemia regard the American engineers as the leaders of the world in the profession and look to them to discharge their responsibilities for such leadership. It was suggested that a meeting of engineers for the promotion of the international association of engineers should be held in the near future in Prague, to familiarize especially the American engineers with the problems involved.

## Dilute Sulfuric Acid in the Liquid Phase

THE fact that certain copper silicates, in which the copper exists as a dilute solution of copper silicate in quartz, were less soluble in $SO_2$ than in sulfuric acid led to an investigation at the Tucson, Ariz. station of the Bureau of Mines, of the possible solvent effects of other salts in solution. It was found that iron in solution noticeably increased the formation of sulfuric acid, which aided dissolution. This suggested the possibility of utilizing the drum as a means of making dilute sulfuric acid in the liquid phase.

In the Bureau's $SO_2$-leaching drum the sulfites are almost immediately oxidized to sulfates. The oxidation of $SO_2$ to $SO_3$ is slow, even under the favorable conditions existing in the drum; iron in solution accelerates this action. The results from a series of tests using pure iron salts under conditions similar to the drum operation indicate the practicability of manufacturing $H_2SO_4$ by chemical reaction. Ferrous sulfite is oxidized by the hot air or oxygen to ferric sulfate. The ferric sulfate reacts with $SO_2$ to make sulfuric acid and ferrous sulfate. To effect the rapid oxidation of ferrous sulfate, it is necessary to get intimate contact with the air or oxygen. This can be effected by heating in the air, using high-speed agitation methods, or by passing the air through a porous medium, such as the Callow cell. The Bureau's drum is the preferred apparatus, as it effects the desired oxidation and at the same time provides for a high utilization of the $SO_2$ needed in the second stage of the reaction.

Tests completed by the Bureau of Mines to date indicate that it is practicable to manufacture 0.5 per cent. $H_2SO_4$ in the leaching pulp during a regular operation. This greatly helps the extraction of copper from the lower silicate minerals.

## Meeting and Exposition in Liége

THE papers to be presented at the meeting of the Association des Ingénieurs sortis de l'École de Liége will be grouped in seven sections: mines, metallurgy, mechanics, electricity, chemical industries, geology, and civil engineering. The mining papers, although largely on coal and oil, will deal with some subjects of general interest, such as rescue work, ground movement and subsidence and estimating ore deposits. The metallurgical papers will relate to various metals.

This Congress and Exposition have been arranged to celebrate the 75th anniversary of the Association. The Congress will be held from June 11 to 16, and the Exposition will remain open until July 14.

Tentative programs and notifications regarding fees are in the office of the secretary of the A. I. M. E., and may also be obtained by writing to the secretary of the Association des Ingénieurs sortis de l'École de Liége, 16 Quai des Etats Unis, Liége, Belgium.

## Cost of Producing Chinese Pig Iron in 1919

THE Hanyang Iron and Steel Works, Hanyang, China, draw their iron ore from their own mines at Tayeh. The cost of production at Tayeh in 1919, according to the London *Ironmonger*, was below $2.80 per ton, but the transportation to Hanyang cost $0.85, which, together with other expenses, brought the cost up to about $4 per ton at the furnaces. This cost has since been lowered by smelting the ore at Tayeh but an allowance must be made for the coke which has to be taken to Tayeh. As nearly equal quantities of coke and of ore are used in the furnaces, the saving effected in transportation is not of much significance. Limestone also comes mainly from Tayeh. The cost per ton at the Hanyang furnaces varied in 1919 between $2.32 and $3.81. These figures include all transportation and overhead charges. Manganese comes from the company's mines at Changlai and Yangshin.

**Minimum Wage.**—The "economic adviser" of a local trade union has estimated $2333 as the minimum wage necessary for a laborer to support his family in the State of New York. The *Times* compares this estimate with the revelation of the income tax returns that out of a population of 10,384,144 in the state only 742,704 reported incomes in excess of $1000 in 1920 and only 433,200 reported incomes of more than $2000.

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# Experiment in Ore-hunting Geology*

By AUGUSTUS LOCKE

Mining Geologist, San Francisco, Calif.

THERE are three matters related to ore-hunting which I wish especially to discuss here: first, the paucity of the special writings applying to it; second, the failure of scientists to concern themselves importantly with it; and, third, resting on these conditions, certain possible activities for economic geologists.

First, as to the writings. Geological papers are being produced in the United States alone at the rate of 10 to 12 shelf-feet per year.[1] But papers specifically for the ore-hunter would go in a slim, annual pamphlet; all that have ever been written would go in a briefcase. The art of technical ore-hunting—geology conceived as a guide to ore—has only a scant literature.

## Amateurish Geologist's Efforts

This fact, in any thought of ore-hunting as a profession, must be deeply significant; for the very lack of a literature is no more a cause than a symptom of insufficiency. We may, indeed, assume that a store of ore-hunting technique lies hidden in the minds of commercial workers, but the scantiness of books denies it; for the nature of the art is such that its ample development, in isolation, by individuals, is incredible. The technical ore-hunter is still a beginner and the geologist in applying his skill to the search for ore is likely even to be amateurish.

For an example of what this statement means, let us watch two examinations of a leached capping area suspected of meaning copper below.

The first examination is made by a geologist, possessed of the "fine touch." The interest of this man is geology for itself, geology as earth-science; it will be a miracle, therefore, if he so change his habits on the instant, we might say, as to concentrate wisely on this particular, commercial problem. And, even should he so concentrate, what would it avail him? He can comb the literature without finding a technique to judge this capping by. Nor can he stop to develop it himself. For his employers sit waiting; they need information both cheaply gained and quickly rendered, and, rather than pause a year for their man to develop a means of judgment, they would sink a shaft. The geologist, then, must either resign the job or turn in an opinion technically unworthy.

The second examination is made by an engineer of the well known effective sort—a good business man, understanding well the requirements of size and grade for a commercial development. This engineer makes few subtle distinctions of geology; for him the capping will be difficult indeed to read; but a conclusion is necessary, and he must, therefore, take refuge in his habit of firm decision—he must take refuge in those rule-of-thumb methods which have been found in the business of prospecting to be effective.

But this is not technical ore-hunting. It is, rather, the rough and ready, common-sense method of the prospector applied under the most intelligent auspices. It is the method which still dominates in the search for new ore. It serves now; but its results are like a bridge built without calculation, strong enough to bear the traffic; or like the early automobiles, of disproportioned members and costlier in fifty places than they need be. The method finds commercial ore; but it does so at the price of many a mile of cross-cut in hopeless ground.

## Failure of Scientist to Pursue Ore-hunting

This brings us to the second heading which I outlined in the beginning, the failure of the scientist to concern himself importantly with ore-hunting.

This failure is implied in the scantiness of the literature, and it is involved, I believe, in the necessity for the scientist, if he is to go into ore-hunting, to change his viewpoint; for the scientist and the ore-hunter, have, to begin with, a difference of viewpoint that is vital.[2] One is concerned with geology as earth science; the other with geology as a guide to ore. The first has a tone of grandeur; his interests reach wide—they may even touch the stars. The second has a tone of shrill concentration; the finding of ore is the very focus of his thoughts and he will reach out for wider matters only as they affect that one. His art is

* Paper read at a joint meeting of the American Institute of Mining and Metallurgical Engineers and the Society of Economic Geologists, Sept. 14, 1921, at Wilkes-Barre, Pa.

[1] See "Geology and Geography in the United States" by Edward B. Mathews and Homer P. Little, Article No. 17 of Reprint and Circular Series of the National Research Council.

[2] Max Eastman says that a crowd swarming into a ferry boat will divide itself, part going below to smoke and read the paper, and part going to the upper deck to see what is going by: the deckriders are interested in crossing the river; the smokers are interested in getting across. These two attitudes illustrate the difference here discussed.

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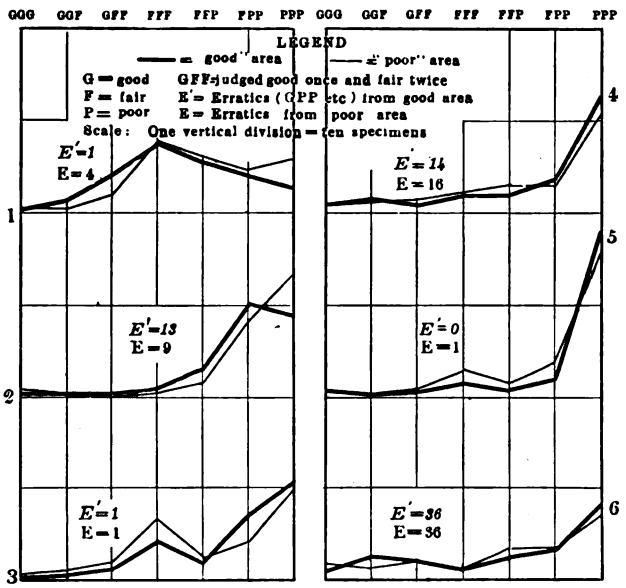
confined to a smaller and more specific geology; it must select for its principal work matters which seem like mere incidents in the larger scheme; and it must be verifiable in detail.

In order to show the process of starting at the necessity and building from that outward, I shall now describe an ore-hunting experiment. This experiment was aimed to determine the degree of doubt in a judgment by six men of two areas of leached cropping over disseminated sulfide stuff. The experiment was as follows:

In one of the Southwestern mining districts, two areas were selected, measuring slightly over 400 by 800 ft., the first over a body of developed ore and the second over material proved by drill holes to be hopelessly low




CURVES EXPRESSING RESULTS OF STUDIES ON TWO LOTS OF DISSEMINATED CROPPINGS SPECIMENS, ONE LOT FROM AREA 400 FT. BY 800 FT. OVER ORE AND ONE FROM SIMILAR AREA OVER WASTE. THERE WERE THREE JUDGMENTS BY EACH OF SIX MEN.

grade and pyritic. The areas yielded about 500 hand specimens taken from the centers of 40-ft. squares. These specimens, numbered according to a key, were thrown into a single heap.

The problem set was for six geologists each to sort the 500 specimens into three groups, good, fair, and poor; good meaning that the specimen came from enriched ore, fair that it came from ore of doubtful grade, and poor that it came from waste.

This sorting was done three times by each man. In addition, 25 specimens were judged with especial care and the detailed basis of judgment was written down. Throughout, such arrangements were made that no particular judgment of a specimen could be influenced by any other, either by the same man or by another.

The task took many hours of work for each man, and before it was finished it developed certain curious aspects. It showed, for example, that so delicate is the balance of judgment that even such a factor as the cloudiness or clearness of the day will influence opinion; and it indicated strange differences among the several men in the basis of judgment. One considered as favorable the tiny pits and gashes made by the departure of sulfide; for, he said, had that sulfide been other than chalcocite, it would have left limonite behind. Another, with equal assurance, regarded the pits and gashes as unfavorable; they meant abundant pyrite; for this, oxidizing, would create so strongly acid a solution as to prevent the precipitation of limonite.

The basis of judgment was proved, at least in some men, to be something felt rather than something known. Despite the experience of all these men in judging disseminated capping, their foundation, at least in part, was grossly unscientific.

Another surprising matter was the inability of certain men to maintain a standard. When, say, specimen 15 was judged by a particular geologist poor twice and fair once, that was considered satisfactorily consistent; but if it was judged good once, fair once, and poor once, by the same man, or good once and poor twice, that specimen was called erratic, for something was clearly the matter.

Among the six men, one had 72 erratics, another 30, another 22, another five, another two, and another only one. This last result was astonishing; it meant that one man so sternly maintained his standard that he was able to go through 500 specimens three times, and classify only one of them erratically. Half a dozen or a dozen erratics seemed a reasonable number.

The results from each man were platted in a pair of curves, one representing the area over ore and the other the area over waste; and, in order that the results of three judgments might be put in a single curve, the individual specimens were classified as follows:

(1) Judged good three times.
(2) Judged good twice, fair once.
(3) Judged good once, fair twice.
(4) Judged fair three times.
(5) Judged fair twice, poor once.
(6) Judged fair once, poor twice.
(7) Judged poor three times.

The pairs of curves are shown in the accompanying figure. The reader will note that, of these pairs, three express a preference for the poor area, two for the good area, and one is non-committal. Had these men been forced, on the basis of these specimens, to choose one of these areas for drilling, three would have put the holes in the poor area, two in the good area, and one would have been unable to decide.

No geologist, however, would have undertaken, on the basis of these specimens alone, to make a decision, for there are too many obvious difficulties in using 500 hand specimens as a sample of 16 acres of capping. It would be necessary, before putting any reliance on these specimens, to check them by a parallel set taken with the squares moved over a few feet; and the

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probability is that several thousand instead of several hundred would be a necessary minimum to constitute a fair sample.

The important matter is not the choice between the areas. Rather, it is the definition of the degree of doubt. This particular place was chosen, I may say, because it was especially pyritic for an enriched disseminated deposit, and because it was therefore especially difficult. The establishment, among the several men, of the fact that the standards differ and that at least some of these men so far as this district is concerned have no solid basis of opinion, is the important matter, and the experiment suggests a score of directions for its amplification and refinement.

In the croppings problem of this particular district, and of disseminated copper districts in general, the scientist has shown but moderate interest. To carry the general problem through to a conclusion would cost perhaps a hundred thousand dollars and would take several years of time by research geologists of the highest grade. I wish to emphasize my belief that it is a thoroughly worthy activity for men who now devote themselves to geology as earth science. The existence of the commercial aim involves no necessary lowering of ideals. And, if "the test of theory is prophecy," then may not this specific test of prophesying ore, with its rigid compulsion of accuracy, even work a benefit to the larger geology itself?

### Definition of Special Ore-hunting Problems Desirable

To come to the third part of the outline given early in this paper—what might be the possible activities of this Society in regard to the conditions above discussed?

The outstanding activity that I wish to suggest is the definition of special ore-hunting problems—problems whose attack would help to build an ore-hunting technology. It is true that some geologists are doubtful if such problems exist—and it is true, furthermore, that the search for ore is now conducted as though they did not exist—but it would seem a proper business for the Society to combat this attitude by lively preparations for broad commercial research. This is the very moment for the application of the finer technical methods, and we may hope, till metals become transmutable, that the ore-hunting art, constantly improving, will bring us more and more swiftly toward results useful in terms of human life.

## Accident Rates for Mineral Industries

ACCORDING to data of the comparative accident rates for all divisions of the mineral industries compiled by the United States Bureau of Mines for the year 1920, the lowest fatality rate was for sandstone and bluestone quarries. These employ a relatively small number of men and all work is done in daylight, free from many dangers that are inherent in underground mining. For the same year, the highest fatality rate was that for gold, silver, and miscellaneous metal mines, a group that includes all metal mines except those producing copper and iron and those in the Mississippi Valley that produce lead and zinc.

No reports of nonfatal accidents at coal mines are received by the Bureau of Mines, but for all other branches of the mineral industry the highest injury rate was that for the lead and zinc mines of the Mississippi Valley, while the lowest was that for marble quarries.

Since the enactment of compensation laws by nearly all of the states, increased importance attaches to the accuracy and completeness of the statistical publications on industrial accidents. The insurance premiums that operators of metallurgical plants, mines, and quarries have to pay are determined largely from a study of statistical reports relating to accidents in these industries. It is highly advisable, therefore, that full and accurate data concerning accidents be reported promptly by operators, not only to aid in the study and prevention of such accidents, but also to assist state compensation commissions and other insurance bodies in establishing premium rates that will be fair and equitable.

As the practical usefulness of statistical reports are increased or diminished by the promptness or tardiness with which the figures are published, the Bureau of Mines hopes that its annual inquiries relating to accidents may be filled out by all operators and returned promptly, in order that the value of the reports of the bureau on this subject may not be diminished by any unnecessary delay in their publication.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Amer. Chem. Soc | Birmingham, Ala. | April |
| Amer. Welding Soc | New York, N. Y. | April 27 |
| Amer. Electrochem. Soc | Baltimore, Md. | Apr. 27–29 |
| Public Conference on Commercial Engineering | Pittsburgh, Pa. | May 1–2 |
| Iron & Steel Inst | London, England | May 4–5 |
| Amer. Zinc Inst | St. Louis, Mo. | May 8–9 |
| Amer. Soc. Mech. Engrs | Atlanta, Ga. | May 8–11 |
| Foreign Trade Convention | Philadelphia, Pa. | May 10–12 |
| Amer. Foundrymen's Assn. | Rochester, N. Y. | June 5–9 |
| Inst. of Metals Div. A. I. M. E | Rochester, N. Y. | June 5–9 |
| Soc. Automotive Engrs | White Sulphur Spr., W. Va. | June 20–24 |
| Amer. Assn. for Adv. of Sci. | Salt Lake City, Utah | June 22–24 |
| Amer. Soc. for Test. Mats. | Atlantic City, N. J. | June 26–July 1 |
| Assn. des Ingénieurs sortis de l'École de Liége | Liége, Belgium | June 11–16 |
| 13th Intl. Geol. Congress | Brussels, Belgium | Aug. 10–19 |

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# Government Action of Interest to Engineers

## Extracts from Weekly Bulletin Issued by American Engineering Council

MARCH 16, 1922

**Patent Office Reorganization Bill.**—The appropriation necessary to carry into effect the recent law authorizing the reorganization of the Patent Office was assured when the Senate and the House of Representatives approved the conference report on the Deficiency Bill which carries $158,000 for the Patent Office. The reorganization scheme necessarily must be put into effect gradually. Due to the heavy accumulation of applications it will require, even with an additional personnel, many months before applications can be assured of immediate handling.

**Trade Associations Conference.**—The purpose of this conference, to be held in Washington in April, will be to secure a list of trade associations, provide for furnishing statistical information suggested by the Department of Commerce, discussion of means and methods for collecting and distributing this information.

**Metric System Bill.**—Hearings have been closed on the Britton-Ladd Metric System Bill and the McNary sub-committee of the Senate Committee on Manufactures is considering a report which it will make to the full committee. "An American Decimal System of Weights and Measures" is the title of a leaflet covering a statement recently made by Samuel Russell before the Senate Committee on Manufactures.

**Chemical Warfare Service.**—Anticipating greatly reduced activities on the part of the Chemical Warfare Service as a result of the new treaty, the Committee on Appropriations of the House has cut the funds to be available to the Chemical Warfare Service during the next fiscal year from $1,500,000 to $500,000.

**Consolidation of Railroads** into a limited number of systems will be the subject of a hearing to begin on April 24 before the Interstate Commerce Commission under the leadership of Commissioner Hall. The first sessions will be devoted to roads in the southeastern region. This is the first action in this matter by the Commission since the adoption of the general plan last August.

**Alaska Investigation by the Department of Commerce.**—Assistant Secretary C. H. Huston will conduct an investigation this summer, to determine ways in which the Coast and Geodetic Survey, the Lighthouse Service, the Steamboat Inspection Service and the Bureau of Fisheries can assist in developing the territory.

**Analysis of the Coal Situation** has been issued by the Coal Bureau of the National Resources Department of the U. S. Chamber of Commerce, for the purpose of giving business men information regarding possible fuel supplies in the event of a strike by the miners on Apr. 1. The bulletin carries charts, covering conditions in various localities in the United States, and explains factors that will control supplies.

MARCH 9, 1922

**President's Conference on Unemployment.**—The Committee on Civic and Emergency Measures has issued from the Department of Commerce a compilation of the articles written on this conference under such titles as "Hoover on Unemployment," "Work for a Restless World," "Keeping Them on the Pay Roll," "Ten Helps for Slack Job Periods," etc.

MARCH 3, 1922

**Hudson River Tunnel and Unemployment.**—Chief engineer of the new Hudson River tunnel notified representatives of the President's Conference on Unemployment that the contract for construction of the subaqueous portion of the great sub-roadway would be awarded during the week of March 6, by the two State Commissions and will give work to thousands of men for several years to come, as well as indirectly aiding unemployment through the states.

FEBRUARY 23, 1922

**Cyclical Depressions.**—A conference was held at the Department of Commerce under the auspices of the Unemployment Conference on Feb. 20 to consider plans for investigating cyclical depressions. The standing committee of the Unemployment Conference has secured sufficient funds to make a quick intensive study to extend over a period of six months. Mr. Hoover made a short address and actively participated in the conference, which was attended by representatives of many important organizations. By request of the chairman of the Conference, the executive secretary of the Federated American Engineering Societies outlined suggestions for some phases of the course of procedure. The American Engineering Council at its meeting in January accepted Mr. Hoover's invitation to take part in this investigation.

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**Topographic Mapping.**—The Senate Appropriations Committee has reported the Department of the Interior bill to the Senate carrying $400,000 for topographic survey work. This is an increase of $125,000 over the amount carried in the same bill when it passed the House last week.

**Patent Convention with Germany.**—The Senate adopted the following resolution on Feb. 22, which will have the approval of the President: WHEREAS under the treaty concluded between the United States and Germany, signed on Aug. 25, 1921, to restore friendly relations between the two nations the right is secured to the United States to revive, by giving notice to Germany, any treaty or convention in force between the two nations prior to the outbreak of war: BE IT RESOLVED (two-thirds of the Senators present concurring therein): That the Senate advise and consent to the giving of notice by the President to revive the patent convention concluded on Feb. 23, 1909, between the United States and the German Empire.

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## Investigations by the Bureau of Mines*

**Storing Carbide with Explosives** (Serial No. 2280). By Charles E. Munroe.—This paper indicates a variety of ways in which accidental ignitions or explosions may occur with commercial calcium carbide. It shows that it is unsafe to store carbide in the same magazine with explosives or in close proximity to them, and, moreover, that such storage violates a fundamental rule of practice governing explosives magazines.

**Dust Reduction by Wet Stopers** (Serial No. 2291). By D. Harrington.—In the study of miner's consumption it has been found that dry drilling, especially in unventilated places, is by far the most dangerous underground occupation. The introduction of machines with water injection through the drill for cross cutting and driving readily controls the dust menace for practically horizontal holes or those with a downward inclination. This paper gives data on air dustiness with various kinds of drilling in two mining regions, and concludes that water stopers are greatly to be preferred to dry stopers.

**Present Status of Coal Carbonization at Low Temperatures** (Serial No. 2292). By Joseph D. Davis.—For 20 years an enormous amount of experimental work has been done in this country and in Europe on the carbonization of coal at low temperatures. Most of this work has been carried out on a laboratory scale, or at least on a semi-commercial scale, and only recently have results been obtained that can be used directly by the carbonization engineer. One object in view has been to learn from a purely scientific standpoint more of the composition of coal and its thermal decomposition. Another object has been the discovery and commercial development of more economical methods for processing fuels than the well-known high-temperature methods. This paper, which was presented at a meeting of the American Gas Association, Nov. 9, 1921, in Chicago, deals more particularly with the latter phase of the work.

**Precautions to be Observed in Entering Abandoned Exploratory Shafts and Pits** (Serial No. 2295). By Byron O. Pickard.—The Berkeley safety station of the U. S. Bureau of Mines was recently informed that a geologist was killed through entering an abandoned 90-ft. exploratory shaft without making a preliminary test of the shaft atmosphere. This is the second recent accident in abandoned workings.

The simple precautions in this paper are probably known to every experienced miner, but evidently are not always practiced, and the writer feels that certain publicity to common sense practices is warranted.

**Underground Loading Devices in Metal Mines** (Serial No. 2300). By C. Lorimer Colburn.—During the period of the war and immediately thereafter development of the use of underground loading devices made most rapid progress. The mining engineers of the U. S. Bureau of Mines in every section of the country have secured, with the coöperation of the mine operators, data on the actual performance of the mechanical shovels in their districts, and have made them available to the author of this paper. No effort has been made to discuss exhaustively the subject of underground loading devices. The object has been to collect in one paper records of the performance of all machines now in actual use. Nine machines are described, also slushers and drag scrapers.

**Methane in California Gold Mines** (Serial No. 2303). By Byron O. Pickard and E. D. Gardner.—Out of five California gold mines in which the air was sampled, three showed accumulations of methane great enough to be ignited. Methane has been reported in a fourth mine.

It is concluded, from the study in California, that methane is given off from certain carbonaceous rocks which are associated with many of the California mineral deposits; also that methane may be given off from timbers decomposing under water. It is believed, therefore, that any operator who has any of the above conditions in his mine should give serious thought to mechanical ventilation and properly controlled air currents in his workings.

**Fighting a Mine Fire With its Own Gases** (Serial No. 2325). By C. A. Allen, and A. C. Watts.—In the No. 3 Sunnyside mine of the Utah Fuel Co. a disastrous fire started on the afternoon of Aug. 17, 1920, the effects of which are still present in the mine. This paper is a summary of a more complete report, prepared by the writers, which will be published by the U. S. Bureau of Mines.

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* Reports in full may be obtained from the Director of Bureau of Mines, Washington, D. C. Give serial number.

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# Correspondence and Discussion

## Evolution of Mechanical Roasting

IN THE December issue of MINING AND METALLURGY, I have read with pleasure A. S. Dwight's very interesting paper on this subject. I appreciate his kindly reference to my furnace. He speaks of knowing it as being used only in Butte. As a matter of fact, about forty furnaces were erected, although, as most of them were somewhat changed in design by the E. P. Allis Co., which furnished the steel work for them, they were perhaps better known as the Holthoff-Wethey furnace.

In June, 1888, when I was put in charge of the Butte Reduction Works, we had only two hand rabbling brick calcining furnaces. They had a capacity of eight tons each per day of 24 hr., and were fired with wood that cost $5 per cord. The men were paid $3.50 per shift of 12 hr. The ore was roasted from 38 per cent. sulfur down to 5½ per cent. The cost per ton was $3.50. In 1889, we put in a small Bruckner cylinder having a capacity of seven tons to the charge, and in 1891 a second but larger Bruckner capable of holding 14 tons.

The old practice was to discharge the hot calcines into pits and turn water from a hose on them before throwing them by hand into the reverberatory furnace. I made several tests of the effect of cooling the calcined material in this manner, and found that it caused a large percentage of loss in copper and silver and of course kept down the capacity of the smelting furnaces. The cost of calcining ore in the Bruckner cylinders was $2.35 per ton.

In 1893, after seeing the Cole-Keller furnace in operation at the Parrot smelter, and the Pearce furnace at the Colorado smelter, I concluded that neither one of them would meet our conditions. At that time the Pearce was a single-deck furnace. I considered the Parrot furnace too clumsy and involving too much complicated mechanism. I desired a furnace having the most simple form of mechanism, and the greatest capacity possible in a given space, for we were restricted both in area and height. These requirements led to my designing a furnace best calculated to meet these conditions.

The first furnace occupied part of the space previously occupied by a hand-roasting furnace, and a Bruckner cylinder, and started in operation in September, 1894. It was arranged to deliver the hot calcined material to the reverberatory furnaces, and greatly increased their capacity, as the hot material dropped through holes in the roof of the furnace instead of being thrown in by hand through side doors.

The first furnace proving satisfactory, three others were built, and in 1904 the four furnaces[1] averaged 266 tons daily for the entire year. The cost of calcining had been reduced to about 35 cents per ton. About 4 per cent. of Rock Spring slack coal was used per ton of concentrates and slimes. The men were paid $3.50 for an 8-hr. shift, instead of the old 12-hr. shift. The costs, too, were figured on the dry weight, and as the percentage of moisture was very much greater than in the early years when much screenings from coarse ore was used, instead of the wet slimes we afterwards had to treat, the saving in cost was really greater than the bare figures actually show.

Inventing a furnace brought in a train of litigation. Cole-Keller and Gaylord claimed that my furnace was an infringement of theirs. I settled this by buying Cole's interest in that furnace. Horace Brown, who owned the O'Hara patents, claimed that both the Cole K-G furnace and mine were infringements on his. After much litigation, and getting a favorable decision in the federal court at Seattle, I settled with Brown by turning over my patents to him, retaining all royalty on furnaces already sold, and securing the right to all purchasers of my furnaces to continue their use without interference of any kind. I was the more ready to do this as I realised that this type of furnace was getting out of date, being inferior to such furnaces as the improved Pearce, McDougall and Wedge furnaces.

A. H. WETHEY.

PARIS, Jan. 2, 1922.

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**Permissible Carbon Monoxide Indicators.**—Schedule 18, issued by the United States Bureau of Mines, gives the procedure for establishing a list of permissible carbon monoxide indicators that are light in weight and portable for quickly and easily showing presence of carbon monoxide gas in mine rescue and recovery operations; or around blast furnaces, producer-gas and water-gas plants, and metallurgical and chemical plants. Examinations and tests of carbon monoxide indicators submitted by manufacturers will be made at the Experiment Station of the Bureau of Mines at Pittsburgh, Pa. Copies of Schedule 18 may be obtained from the Bureau of Mines, Washington, D. C.

[1] Occupying the same space formerly occupied by the two old furnaces and two Bruckner cylinders.

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# Abstracts of Institute Papers

The following papers will be printed in full in the TRANSACTIONS. A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 22 of the Advertising Section. Discussion of papers is invited.

## Testing Artillery Cartridge Cases*

BY J. BURNS READ, GOLDEN, COLO., AND S. TOUR, NEW YORK, N. Y.

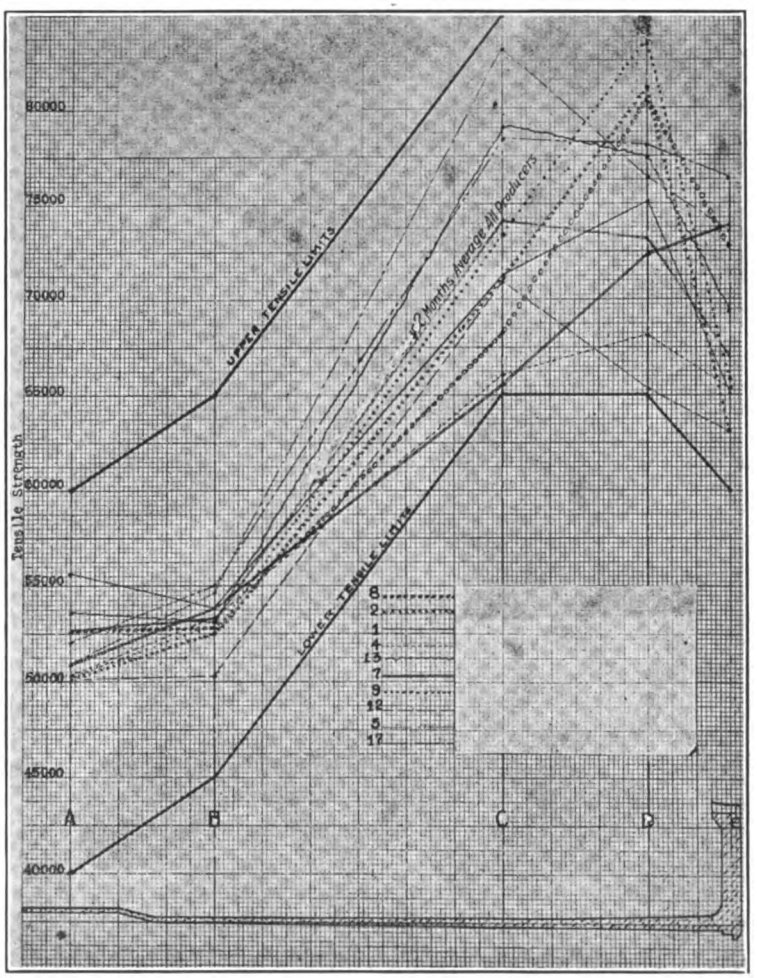
IT IS the purpose of this paper to summarize, as far as possible, the metallurgical information and experience gained by the Ordnance Department, during the war, in the manufacture of artillery cartridge cases, to describe the tests to which artillery cartridge cases were put, and to summarize the knowledge and experience gained in this testing.

Artillery cartridge cases are cold drawn from circular disks punched from strips of rolled brass. The manufacture involves from 25 to 30 main operations, which are done almost entirely on a punch press. After each cupping, or drawing, operation, except the last, the cases are annealed at from 540° to 650° C., to remove all the hardening strains set up in the metal and to allow complete recrystallization. After each annealing, the cases are pickled in nitercake or sulfuric-acid solution and then washed in water to remove all traces of acid. In some instances, the cases are then immersed in a cyanide-salt solution, and afterwards rinsed in water, to remove the thin layer of copper that forms on the surface of the cases during the acid pickle.

The last cold-drawing operation is followed by the heading operation which, by flattening the head of the case on the outside, causes the metal to flow on the inside to approximately the proper finished dimensions. The mouth, or open end, is then annealed at 430° to 480° C. by immersion in a salt bath or by gas flames. After being washed, the cases are tapered, when they are ready for machining, inspection, and testing.

Good disks of proper composition and physical properties are essential to the production of good cartridge cases. The Ordnance Department has specified the following chemical composition: copper, 68 to 71 per cent. and zinc, 29 to 32 per cent. It requests that copper plus zinc, minimum, equal 99.88 per cent.; lead, maximum, equal 0.07 per cent.; iron, maximum, 0.05 per cent.; tin, antimony, bismuth, cadmium, or arsenic, none or only a trace. The materials used are prime lake or best electrolytic copper and grade A zinc.

The specifications do not give physical properties




COMPARATIVE TENSILE STRENGTH TESTS OF TYPICAL 75-MM. CARTRIDGE CASES FROM DIFFERENT MANUFACTURERS.

but suggest that, "An average of ten readings should be between 50 and 65 Brinell and no individual test should be below 49 or above 69." A very soft or a very hard disk has a tendency to punch through instead of cupping. The harder the disk, the greater is the strain on the press forming it into a cup, but it is generally believed that the harder disk will form a better case than a soft

*New York Meeting, February, 1921. Publication delayed by arrangement with Institute of Metals Division.

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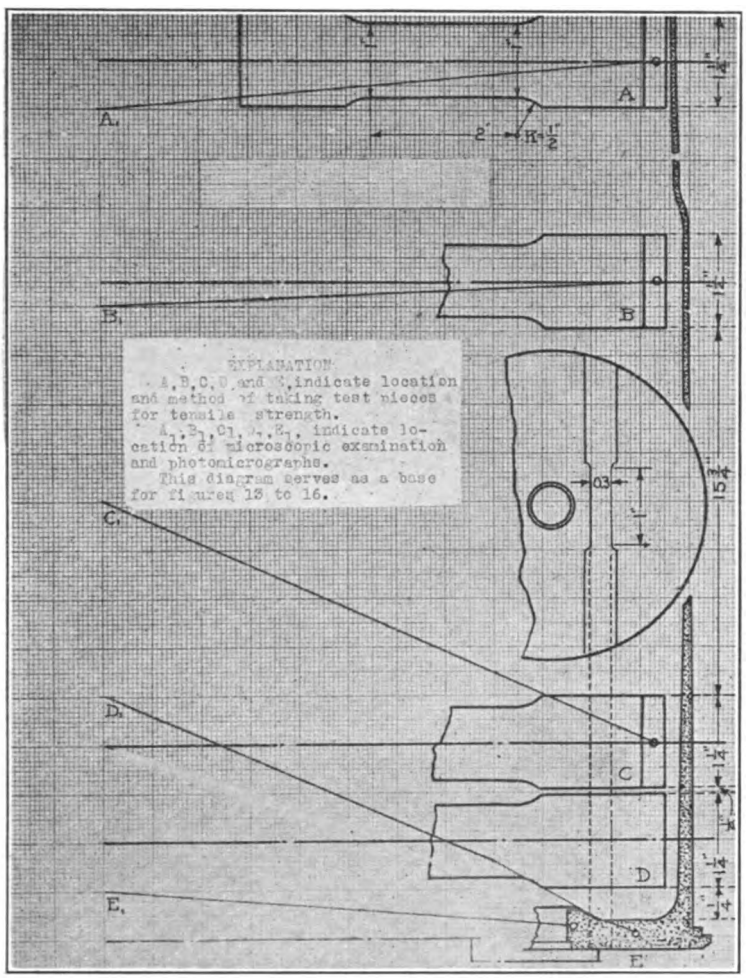
disk. Whether this is true will depend on the conditions of working and annealing in the process of manufacture. If these conditions are properly controlled, very soft and very hard disks will form equally good cases.

The testing of cartridge cases for acceptance may be divided into five sections: chemical analysis, determination of tensile strength and percentage of elongation, microscopic and macroscopic examination, mercuric-chloride test, and ballistic, or proof test. The testing by chemical analysis will not be discussed here.


EXPLANATION
A, B, C, D and E, indicate location and method of taking test pieces for tensile strength.
A1, B1, C1, D1, E1, indicate location of microscopic examination and photomicrographs.
This diagram serves as a base for figures 13 to 16.

METHOD OF TAKING TESTS OF 3-IN., 15-PDR., ANTIAIRCRAFT CASES.

During the recent emergency, the metallurgists of the Ordnance Department based their work on artillery cartridge cases on the idea that starting with a disk made of high-grade cartridge brass that had passed a thorough visual inspection, with a well-ordered shop practice covering thorough control of annealing and amount of draft, the finished case is bound to meet all requirements specified by laboratory tests, and gun-proof, in so far as the material is concerned.

Up to the time the United States entered the war, little attention had been given to the metal quality of cartridge cases. Specifications mentioned metal conditions and placed no limits other than chemical. Little systematic consideration had been given to the possibilities of control of the final product by the control of manufacturing processes. Because of many changes resulting from quantity manufacture and an increased knowledge of the requirements of cartridge cases, it was necessary to revise these specifications. The revision requires photomicrographs if the microscopic examination continues to reveal an unsatisfactory condition of the crystallized structure in several lots. This would indicate that photomicrographs, when the metal is good, were not to be taken.

The revision also provides for tensile and mercuric-corrosion tests "merely for the guidance and general information for the manufacture, and no lots will be rejected if cases fail to pass these tests." It retained the requirements of the previous specifications as to ballistic tests and storage. In order to provide for the proper application of these general specifications, from time to time instructions were issued to inspectors directing, in detail, methods of inspection and test.

One of the first instructions directed that microscopic examinations include the making of photomicrographs. These instructions required that photomicrographs of six sections be made from each of five cases taken at random from every lot. It was then thought that the photomicrographs would furnish sufficient information for proper control of the inspection. This did not prove to be the case because of the many variables in worked brass that has not been annealed. Inexperienced personnel, varying processes of manufacture, and varying laboratory methods added to these variables and the photomicrographs did not reveal the quality of the case which they represented.

Later instructions provided optional methods of testing each lot as follows: Mercuric test of one case and microscopic examination and photomicrographs of this case and five others, six in all being required; or, tensile-strength and elongation tests of two cases, mercuric test of one case, microscopic examinations and micrographs of one case, four cases in all being required. Samples of the product of several contractors were sent to the Bureau of Standards for mercuric-test study and tensile-strength tests; the results showed that these tests were a proper means of inspection. Under either method of testing, a failure of a case to stand the mercuric test and retest constituted a rejection of the lot it represented. At first most, and later all, of the contractors adopted the second method of testing. Final acceptance or rejection, of course, is based on the results of the ballistic test.

The physical and microscopic properties of the metal of cartridge cases are largely dependent on the combined control of the various annealings and redraws, particularly the last. An increase in the amount of work done on the metal in any step reduces the tem-

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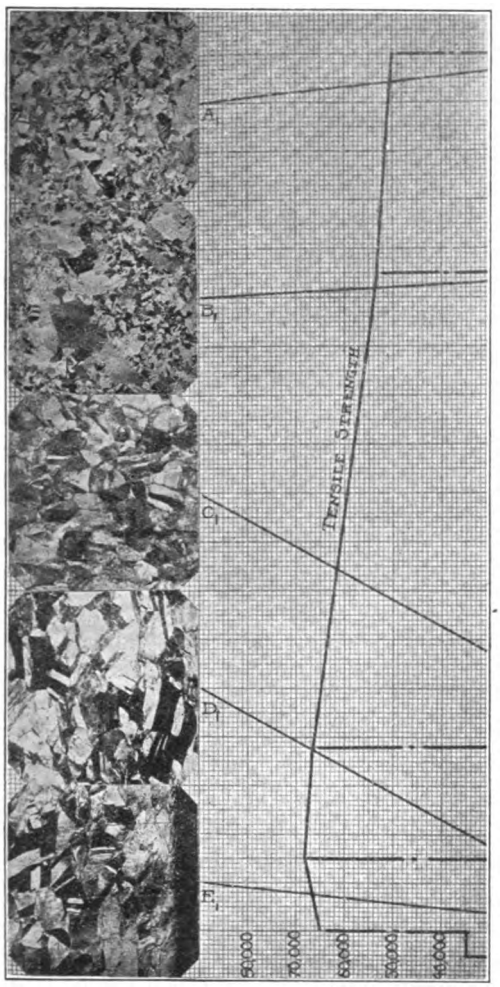
perature at which the anneal of that metal will take place, and vice versa. Therefore, as the work affects the results of the anneal, the anneal affects the results of the work and both affect the physical properties. It is essential that these be considered together.




STRUCTURE AND TENSILE STRENGTH OF 75-MM. CASE AS MADE BY MANUFACTURER NO. 12.

## CONCLUSIONS

1. Tensile-strength requirements are now sufficiently established by the experience during the war to warrant their being placed in specifications and used in deciding the acceptance or rejection of cases.

2. The mercuric test has been met by reliable manufacturers, is a good test for control of the manufacturing process, is a sure indication of the behavior of the case in storage, and indicates a metal condition that cannot be detected by chemical, physical, or microscopic tests. It should, therefore, be made a definite requirement in the specifications for cartridge cases.

3. Microscopic examination should be made of a portion of the cases submitted for tensile-strength tests, also of samples of all questionable material. Photomicrographs are essential as a record and for purposes of comparison; their number will depend on conditions.

4. Ballistic tests alone are not a sufficient or proper test of cartridge cases. Except on material that is questionable, metallurgical tests taken with proper dimensions and visual inspection are sufficient and more reliable than ballistic tests.

5. The present requirements and specifications for cartridge-case disks are satisfactory.

6. Indications are that hardness tests, made by the Baby Brinell machine without cutting up the cartridge case, might be substituted for the tensile-strength test. Such tests would increase the sample, decrease the work, and save the case.

7. The low-temperature anneal (below recrystallization temperatures) seems so certain of overcoming all season cracking that its employment in the manufacturing of cartridges should be seriously considered.

8. More judgment should be used in rejecting cartridge cases because of slight visual defects.

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# Present Conditions in Mexican Oil Fields and an Outlook Into the Future*

BY VALENTIN R. GARFIAS, NEW YORK, N. Y.

THE various phases of the Mexican oil industry have received so much publicity that there is little to add to the discussion of present and future production, extent and importance of prospective fields, and status of petroleum legislation, to mention but a few of the angles of the Mexican oil problem. However, out of this wealth of information, which is generally of contradictory nature, the average petroleum man is at a loss to know something definite regarding the various questions involved, so, keeping the foregoing in mind, it has been the writer's aim to record in a concise form the most reliable and up-to-date information regarding the salient features of the Mexican oil situation.

## PRESENT STATUS OF MEXICAN OIL INDUSTRY

The Mexican oil fields, during 1921, produced in round numbers 203,000,000 bbl. of which 176,000,000 bbl., or 86 per cent., were exported, the bulk of these exports, or about 73.3 per cent., going to the United States. The Mexican exports were divided by grades as follows: light crude, 47.0 per cent.; heavy crude, 22.0 per cent.; tops, 3.5 per cent.; fuel oil from light crude, 24.0 per cent. The remainder, or 3½ per cent., includes the bunker fuel shipments and the coastwise trade in Mexico, which is not classified as to grades. The figures show that, in importance, the light-oil fields mean about 75 per cent. of the Mexican petroleum industry.

The production of the Panuco field has followed the general history of the American fields, and its gradual decline, which is at present foreshadowed, may be estimated as well as its ultimate economic life. On

* New York Meeting, February, 1922.

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the other hand, the behavior of the light-oil fields to the south is unlike any in the world so far discovered, and as a result we have concentrated overproductions followed by sudden droughts, both sometimes equally unexpected. The coming-in of two or three gushers within adequate pipe-line facilities will flood the market with 100,000 bbl. or more a day, while the flooding by water of a particular pool will, in a few weeks, remove from the market one-half the total production of the Mexican fields.

The year 1921 saw the flooding of the southern fields, except Cerro Azul and Toteco, and the bulk of the light-oil production confined to this limited area. The present importance of these fields depends on the productivity of the Toteco-Cerro Azul area, which yields over two-thirds of the total.

The fields producing light oil, as is well known, are located along the narrow strip running from Dos Bocas, on the Tamiahua lagoon, to Alamo, on the Tuxpan river, and possibly to Furbero 30 mi. south, thus forming a slightly curved belt about 1 mi. wide and 76 mi. long called the knife-edge. Excluding the present producing areas, there are about 30 mi. that have been drained of oil and there are about 30 mi. between Alamo and Furbero, where the possibilities of extensions are questionable; 7 mi. between Alamo and Potrero, controlled by two companies, which have obtained production although its real importance remains to be proved; about 4 mi. between Potrero and Cerro Azul, likewise controlled by two companies, where the possibilities of encountering oil are not considered very promising; and an extension of 5 mi. between Tepetate and Dos Bocas, in which important development is going on at the present time and where there are strong probabilities of encountering oil although probably of a heavier grade (14° B.) than the typical product of the region.

Although it is admitted that there are possibilities of encountering oil along the entire belt between Furbero and Dos Bocas, in considering the availability of this supply for the purpose of counteracting the expected sharp decline of the present producing fields about the middle of this year, we can only consider the region between Dos Bocas and Tepetate, which so far has shown a heavier oil than to the south, and the region between Alamo and Cerro Viejo, in which producing wells have been encountered, although reports about this development have been of a contradictory nature.

In the wildcat fields, outside of the so-called knife-edge, 24 wells are being drilled at present. These wells are not near pipe-line facilities and even if some of them should prove successful their production will not compensate for the expected decline in the present fields.

Of late, considerable publicity has been given the results of drilling in the Tehuantepec region and reports of a highly productive flowing well have been circulated. However, no definite information has been obtained regarding this development other than that the well has been ruined and its production become unavailable. Although it is probable that the Tehuantepec region will again be commercially productive, the record of its wells and the small amount of prospecting being carried on tends to the conclusion that the production of this region will not increase soon enough to counteract the expected declines during the present year.

Summarizing the foregoing, we may state that there is a possibility, should an important producing field be developed between Tepetate and Dos Bocas in the next few months, that the intensive development of this area will, to some extent, make up for the decline of the Toteco-Cerro Azul pools and so maintain the Mexican production near its present high level; and that the successful intensive development of the region between Alamo and Potrero may serve the same purpose, but that in this case, owing to the large size of the holdings of two companies, the production would be more intelligently and economically handled and very likely the total exports from the Mexican fields would decline considerably below its present high rate.

## Summary

1. Production of the Panuco field will remain stationary or gradually decline during 1922. Production from the fields yielding light oil should show a sharp decline during the year, beginning some time during the summer.

2. The decline of Mexican production may be partly neutralized if the development work now being started between Tepetate and Dos Bocas proves successful; also, if the result of an intensive drilling campaign between Alamo and Potrero meets the optimistic view held by some operators.

3. Development of wildcat drilling in northeastern Mexico and the Isthmus of Tehuantepec, although of great importance as to the future supply, should not offset the sharp decline anticipated during 1922. Wildcatting is not being carried on in Mexico as intensively as the importance of the industry warrants.

4. Notwithstanding all that has been written, the conditions of the American oil industry did not warrant the sharp decline in prices during the first half of 1921 and present conditions, as regards factor of safety and stability, do not warrant any further curtailment in prices; in fact, the American oil industry, as regards supply and demand, is now under normal conditions and the oil prices should correspond to such conditions.

5. The absolute dependence of the American oil industry, in fact the world's oil industry, on Mexican production, is self-evident and a disastrous effect in the industry from a rapid curtailment of Mexican production will be the logical consequence. It follows that the intelligent development of the Mexican oil fields is a first necessity to the stability of the American oil industry.

6. Mexican taxation is now levied on a reasonable basis, which will do a great deal toward stabilizing

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the world's petroleum industry, as this is absolutely dependent on Mexican and American production. The new, or export, tax levied for the sole purpose of reducing its foreign obligations, has been in effect since July 1, 1921, and must be paid by exporters of Mexican oil either in cash or in Mexican bonds.

7. Perhaps the outstanding feature of the Mexican operations during the last year has been the friendly undertone that has prevailed in all matters in which American operators and Mexican officials have come in contact, this being due primarily to the radical departure from the old practice prevailing for many years when both the Mexican Government and American operators were dealing through intermediaries, mostly attorneys, whereas all dealings during the last year have been transacted between Secretary de la Huerta of the Obregon Cabinet and the presidents of five of the leading American oil companies.

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## Core-oven Tests*

By F. L. Wolf and A. A. Grubb, Mansfield, Ohio

The tests described in this paper were made to obtain information regarding costs, efficiency, etc. of baking cores in an oil-fired oven and two electric ovens, which were installed, early in 1920, by The Ohio Brass Co. and were used almost continuously during the rest of that year. Operating costs were rather high so a complete test was undertaken early in 1921.

The ovens are referred to in this paper as Nos. 1, 2, and 3. Nos. 1 and 2 are electric ovens of different makes while No. 3 is an oil-fired oven made by the same firm that made No. 2. The three are equipped with similar ventilating devices. They have full-height doors at front and rear. The cores are placed on iron racks, which are lifted by Cowan trucks and rolled into the ovens through the front doors. When baked, they are removed through the rear doors. Fig. 1 shows the general plan of the electric ovens while Fig. 2 shows the plan of the oil-fired oven.

The cores baked in the tests were the regular run of cores used in our foundry. They consisted largely of valve bodies up to 3 in. in size, valve fittings, and overhead-trolley fittings. They varied in weight from a fraction of an ounce to about two pounds but averaged about 3½ oz. They were composed of lake and molding sands and sand-blast dust with linseed oil and a small quantity of glutrin as binder.

Each oven was carefully studied to determine the best method of manipulation, heat absorption, heat losses, etc. Test bakes were then made and analyzed as regards heat distribution and costs.

Three special bakes were made in each electric oven in an effort to determine just what became of the power consumed. Evidently part was used in heating the iron racks, plates, etc. from room temperature to the temperature at which they left the oven, part heated the air that entered the oven when the racks were put in and taken out, part heated the air drawn through the oven by the ventilating system, and part was radiated, while the rest was probably used in actually baking the cores. For each of the test bakes, the ovens were held at 400° before putting in the racks and were brought back to 400° immediately after the racks were removed. Time was measured from the entrance of a rack until the temperature was back to 400°, after its removal, and the power consumption, heat losses, etc. over the same period were considered.

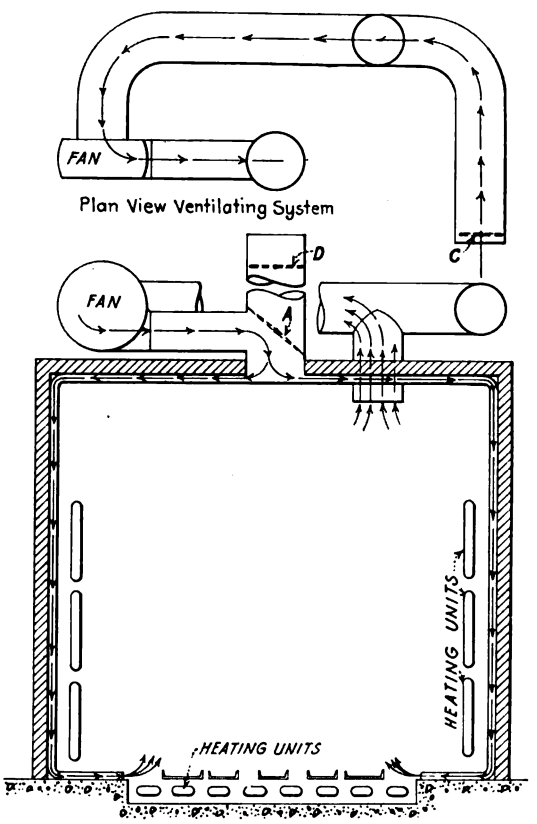


Fig. 1.—Electric core oven.

Considerable trouble was experienced in obtaining a uniform bake in the oil-fired oven-sas the heat issuing from the vents in the combustion chamber struck the cores and burnt those near the edges of the racks while others farther in were green. Bricks were removed from the upper course, at intervals of about 1 ft., and iron sheets placed so that the air from the ventilating pipes was directed down over the edge of the chamber and up through the racks and cores.

This test for uniformity of bakes was run simultaneously in the three ovens, so as to make it strictly comparable. Thirty-nine plates of test cores, five cores on each plate, were made from the same batch of core sand. Thirteen plates were placed on each of three racks together with the regular loads of cores; one was placed on each corner of the upper, middle, and lower shelves and the other in the center of the middle shelf.

*Rochester Meeting, June, 1922.

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The racks were then put into the ovens and baked under the best conditions we could obtain. The cores were then broken on a Wadsworth core-testing machine and the average strength of each plate was determined.

The tests indicate that greater uniformity can be obtained in the electric ovens and the cores are probably a little stronger than in the oil-fired oven.

## Comparison of Ovens

The analyses of bakes given are not directly comparable because racks of different weights and batches of cores of different size and weights were used. The figures below show an average bake and the heat consumption based on such a bake. They are, therefore, a fair comparison of the three ovens.

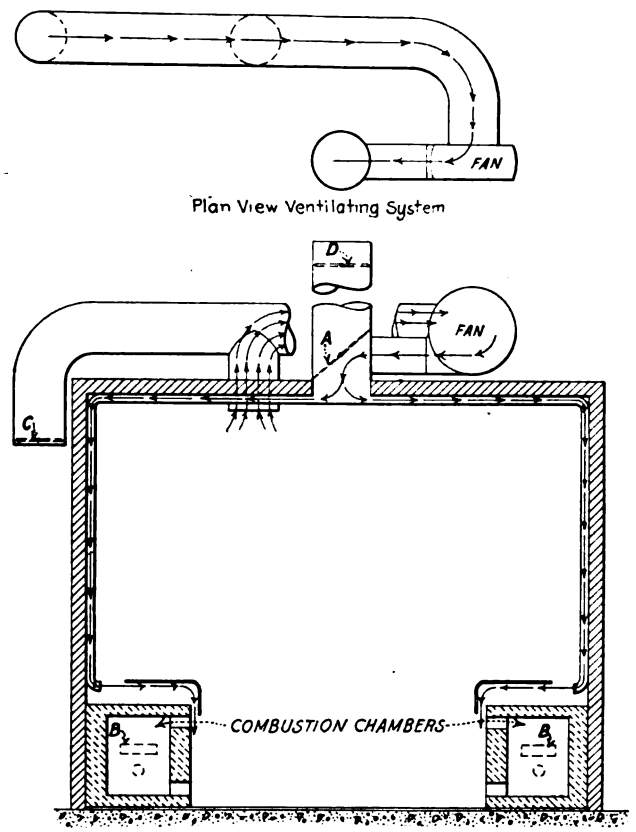


Fig. 2.—Oil-fired core oven.

| | Oven No. 1 | Oven No. 2 | Oven No. 3 |
|---|---|---|---|
| Heat used in bringing oven from room temperature to baking condition, B.t.u. | 192,700 | 191,200 | 694,000 |
| Heat radiated (or lost) while oven is closed as tightly as possible and held at baking temperature, B.t.u. per hour | 67,200 | 81,900 | 102,000 |
| Heat lost and radiated by oil-fired oven while maintaining baking temperature, burners on, fan recirculating, dampers open, B.t.u. per hour | | | 201,000 |
| Average strength of test cores baked at various points in oven, pounds | 49.8 | 48.4 | 42.7 |
| Uniformity: maximum deviation from average strength, per cent | 16.0 | 21.0 | 34.0 |
| Average bake, taken same for the three ovens: | | | |
| Weight of iron rack, pounds | 946 | | |
| Weight of plates, driers, etc., pounds | 1,111 | | |
| Weight of core, net, pounds | 282 | | |
| Average weight of cores, gross, ounces | 3.6 | | |

| | Oven No. 1 | Oven No. 2 | Oven No. 3 |
|---|---|---|---|
| Heat consumption for average bake as above, B.t.u. | | | |
| For heating rack | 36,300 | 36,300 | 36,300 |
| For heating plates, driers, etc | 42,600 | 42,600 | 42,600 |
| For heating air in oven | 5,700 | 8,500 | 80,600 |
| Radiation and other unavoidable losses | 84,500 | 108,200 | 143,200 |
| For baking cores | 33,900 | 33,000 | 47,700 |
| Total | 203,000 | 228,600 | 350,400 |
| Cost per 1000 B.t.u., cents | 0.8052 (2.75c. per kw.-hr.) | 0.8052 (2.75c. per kw.-hr.) | 0.0804 (11.14c. per gal.) |
| Cost distribution for average bake | | | |
| For heating rack | $0.290 | $0.290 | $0.029 |
| For heating plates, driers, etc | 0.343 | 0.343 | 0.034 |
| For heating air in oven | 0.046 | 0.068 | 0.065 |
| Radiation and other unavoidable losses | 0.681 | 0.872 | 0.115 |
| For baking cores | 0.273 | 0.266 | 0.038 |
| Total | $1.633 | $1.839 | $0.281 |

Core losses in ovens Nos. 1 and 3 were observed for comparison. Of 27,000 cores observed, 0.05 per cent. of those baked in the electric oven were burned and none came out green, while 1.95 per cent. of those baked in the oil-fired oven were burned and 2.14 per cent. came out green. This amounted to a loss of 30 or 40 cents on an average for each rack baked in the oil-fired oven against less than 1 cent for the electric oven.

## Conclusions

From the foregoing observations and data, we would conclude that power or fuel costs are decidedly in favor of the oil-fired oven while other considerations such as quality and uniformity of bake, core losses, convenience and cost of tending, cleanliness and noise are decidedly in favor of the electric ovens. Taking into consideration the higher losses in the oil-fired oven and the extra labor cost, the oil-fired oven cost about $0.80 per bake as compared with $1.63 for the electric oven No. 1. All of these considerations are based on the equipment and installation we now have and the present methods of manipulation, both of which we are trying to improve.

## Spies Open-stope System of Mining

Line 35, page 60, March number of Mining and Metallurgy, should read "40 per cent. higher in the shrinkage stope," instead of 4 per cent.

**Accidents** at coal mines in the United States in 1921 resulted in a smaller loss of life than in any year since 1903, according to a report compiled by the Federal Bureau of Mines. Information received from all state mine inspectors shows a total of 1973 men killed, as compared with 2271 in the preceding year, a reduction of 298 fatalities, or more than 13 per cent. The decrease was due largely to the fact that the bituminous mines were idle much of the year. The year was remarkably free from large disasters, there being but five accidents killing five or more men each, resulting in a total of 34 deaths.

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# Personal Notes and Biographies

**W. J. Uren** is general manager of the Seneca Copper Corpn., Mohawk, Mich.

**Sumner S. Smith** is with the Alaskan Engineering Commission, Chickaloon, Alaska.

**R. W. Shumway** is chief engineer for the Coal River Collieries at Huntington, West Va.

**Arthur W. Duston,** who is with the Pierce Oil Corpn., has been transferred to Okmulgee, Okla.

**Louis Wade Currier** is assistant professor of mineralogy at Syracuse University, Syracuse, N. Y.

**James R. Fleming,** recently of Urbana, Ill., is mining engineer with the Mine Safety & Service Co., St. Louis, Mo.

**Frederick M. Shaw** is president of the Idaho Apache Silver Mining Co., with headquarters in the Shaw Bldg., Boise, Idaho.

**Walter Renton Ingalls** has been elected a member of the Executive Committee of the Bureau of Economic Research.

**Frank E. Nichols** recently resigned his position with the Danao Coal Mines, to become a planter at Escalante, Occ. Negros, P. I.

**Hubert Merryweather** is vice-president and general manager for the Bethlehem-Cuba Iron Mines Co., Santiago de Cuba.

**W. P. Gage,** recently with the Lone Star Gas Co., at Dallas, Texas, is now with the Humphreys Pure Oil Pipe Line Co., Houston, Texas.

**W. Armstrong Price** is engaged in subsurface geology for F. Julius Fohs, chief geologist of the Humphreys Oil Co., Dallas, Texas.

**Richard R. Smith** is on his way to South America, where he will be assistant chief engineer for the Compañia Huanchaca, Pulacayo, Bolivia.

**Rudolph C. Schappler,** recently with the Transcontinental Oil Co., Tulsa, Okla., is with the Pocahontas Copper Queen Mining Co., Mayer, Ariz.

**Ralph G. Perry,** recently with the Southern Illinois Engineering Co. at Herrin, Ill., is resident engineer with the Republic Coal Co., Roundup, Mont.

**Samuel B. Goldberg** has been promoted to the position of accountant and paymaster of the Colorado Mining Co., Aroroy, Masbate, Philippine Islands.

**W. M. Corse,** who has been with the Monel Metal Products Corpn., at Bayonne, N. J., for several years, has gone to Washington, D. C. to work with the National Research Council.

**James W. Wilson,** superintendent Lower Departments of the National Tube Co., has been made assistant to the vice-president of that company and has moved from McKeesport, Pa., to Pittsburgh.

**Arthur S. Dwight,** Lieutenant-Colonel in the Engineer Officers Reserve Corps, has been placed in the general assignment group and has been reserved for duty under the direction of the Assistant Secretary of War, General Staff, in time of emergency.

**Percy E. Barbour,** Major, Engineer Officers Reserve Corps, has been attached to the 342nd Engineers, 12th Corps, in the Second Corps Area. This regiment is assigned to Army Corps engineer service.

**L. J. Buck** has severed his connection with the National Carbon Co., and has become sales representative in the United States for the British America Nickel Corpn., Ltd., with offices in the Canadian Pacific Bldg., New York City.

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## Verplanck Colvin

VERPLANCK COLVIN, a member of the Institute for 39 years, died on May 28, 1920, but notice of his death did not reach the secretary's office until early this year.

Mr. Colvin was superintendent of the New York State Land Survey, and had a long record of service to his native state. He was born in Albany, N. Y. on Jan. 4, 1847, and was educated at the Albany Academy and by private tutors.

At Nassau, Rensselaer County, where the family lived during his boyhood, he indulged his taste for outdoor life and laid the foundation of his love for topographical science by preparing topographical maps of the country. He studied law under his father and practiced successfully in the minor courts, but inclined more and more to scientific pursuits. He joined the Albany Institute and organized a successful course of free scientific lectures in the State Geological Hall.

In 1865 he began his exploration of the Adirondack wilderness, at his own expense, and corrected many errors in existing maps of that region. In 1870, he

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made the first ascent and measurement of the height of Mt. Seward, and about that time discovered the remarkable errors of the compass needle in northern New York, which render bearings taken in many parts of those mountains almost valueless. In 1869, he made a careful geologic and topographical survey of the Helderberg Mountains, a brief account of which was published in *Harper's Magazine*. During the latter part of the winter of 1870 he traveled extensively through the southern states, and in 1871 he crossed the great plains to Colorado, visiting Wyoming, Nebraska and the Black Hills. He was the first to ascend, describe and map the highest peaks in the Rocky Mountains, and later wrote an article for *Harper's Magazine*, entitled, "The Dome of the Continent," which caused the name "Dome State" to be first applied to Colorado. He was elected an honorary member of the Rocky Mountain Club of Denver, an honor rarely conferred.

In 1872, Mr. Colvin induced the New York State Legislature to make an appropriation for the state survey in the Adirondack region, and in the same year he was made superintendent of that work and of other state surveys. He traced the Hudson River to its highest pond source, Lake Tear of the Clouds, on the south flank of Mt. Marcy. In 1873 he was appointed one of the Commissioners of State Parks of New York. In 1875, he made the first true measurement with level and rod of Mt. Marcy, the highest peak in New York State.

His services have been of great value to the state and to science at large, and the highest mountain on the east shore of the lower Ausable Lake, in the eastern Adirondacks, bears his name.

In 1888, when the national government was proposing to erect new gun foundries, he showed in an able paper that the most secure location for the factory was at the Watervliet Arsenal, near Albany. Congress adopted his views and he was called into consultation by the ordnance officers of the United States Army.

Mr. Colvin also acted as consulting engineer on location of railroads. He was at one time president of the Schenectady and Albany Railroad Co. and was a director and officer in other railroad companies, among them, the Canadian Pacific Railway.

## Donald G. Campbell

DONALD G. CAMPBELL was drowned at Hoggum Bay, near Olympia, Wash., on Dec. 18, 1921, while on a duck-hunting expedition. He was a member of the firm of Campbell, Wells & Elmendorf, of Seattle, and had been a member of the A. I. M. E. for five years.

Mr. Campbell was born at Port Arthur, Ont., in 1887. He took the B. S. degree at Whitman College in 1912; the M. A. degree at Columbia University in 1913 and E. M. in 1914. In 1914–15, he was instructor of metallurgy in the University of Washington. In 1915–16, he did exploration and development work at mines in southern Idaho, and was later connected with the A. S. and R. smelter at Tacoma, Wash. In 1916, he established the firm of Campbell, Wells & Elmendorf. During the first year of the firm, he discovered palladium in lode deposits near Ketchikan, Alaska. In 1918, he acted as consulting engineer for various mining properties being developed in the Northwest. During 1919–20 he acted as engineer and metallurgist for a company developing a lode tin property near Nome, Alaska, taking his family with him, and living for over a year at the camp. In the past year he has been engaged in work for the Wrangell Pulp and Paper Co., looking toward the development of this new industry in Alaska.

He wrote, "The Flotation Process," published by the McGraw Hill Co., and "Palladium in Alaska Lode Deposits," which appeared in the *Mining & Scientific Press* of October, 1919.

Mrs. Campbell and two sons, Donald Durant and Gordon Freeston, six and four years old, survive him.

## Leonard H. Whitney

LEONARD HILLARD WHITNEY was killed in the Katherine mine, near Kingman, Ariz., on Dec. 17, 1921. While engaged in erecting a hoisting engine, Mr. Whitney was struck in the head either by the fly wheel, or by a piece of metal thrown from it, and was killed instantly. He had been assistant superintendent of the Katherine mine for some time, and was spoken of as an unusually promising young engineer and a man of most excellent personality.

Mr. Whitney graduated from the University of Illinois in June, 1917, but had interrupted his college course to take part in the great war. He obtained a commission as First Lieutenant at the Officers Training Camp at Fort Sheridan, and served overseas.

He was 27 years old, and had been a member of the A. I. M. E. for four years.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Feb. 18, to Mar. 20, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1921 | Baldwin, George P. | Jan. 28, 1922 |
| 1897 | Burger, C. C. | March 10, 1922 |
| 1915 | Caples, James Watts | Sept., 1919 |
| 1892 | Clement, F. H. | Feb. 18, 1922 |
| 1915 | Hoffman, Lloyd | Feb. 21, 1920 |
| 1892 | Huntley, Dwight B. | March, 1921 |
| 1919 | Lindstrom, Reuben L. | Dec 12, 1921 |
| 1914 | Magnus, Benjamin | March 12, 1922 |
| 1917 | Salmon, George J. | March 1, 1922 |
| 1905 | Steel, Henry | |
| 1919 | Thornton, Edmund A. | Jan. 9, 1922 |
| 1918 | White, John H. | Dec. 28, 1921 |

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# Institute Affairs

## Transactions Desired

IT HAS been suggested that when members of the Institute, by reason of their change of profession and interest, resign from the Institute, their collection of the TRANSACTIONS may be of no further use or interest to them and that these might well be donated or sold to the Institute as the occasion requires.

The Institute has a considerable stock of back TRANSACTIONS with the exception of a few numbers which are out of print. These scarce volumes are always in demand and it would not only benefit the Institute but satisfy a large number of requests if we could obtain these volumes. It is probable that the estates of our deceased members may be unaware of any recipient who would appreciate a collection of the TRANSACTIONS, and we wish that our members would have this in mind and make suggestions in cases that come to their notice.

PERCY E. BARBOUR.

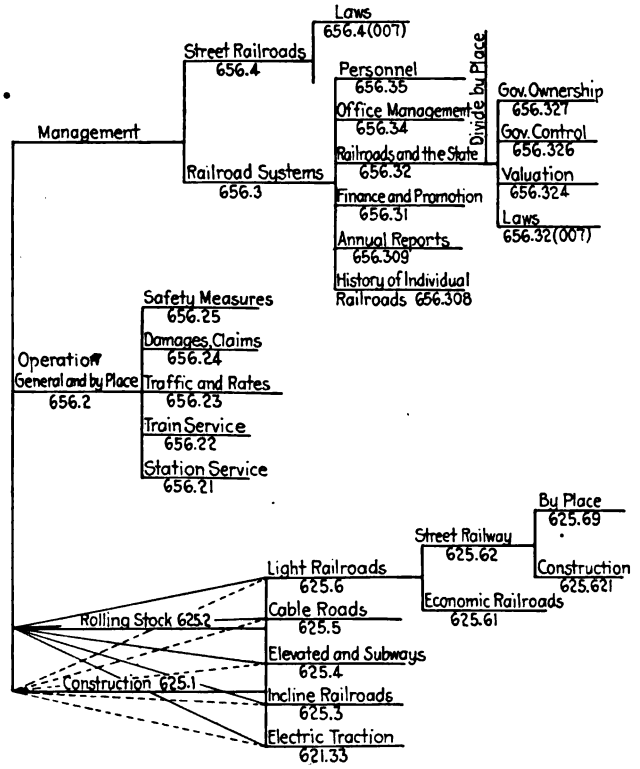
## Cataloging and Recataloging the Engineering Societies Library

CATALOGS, bibliographies and indexes are the tools with which the student quarries from a library the information that will help him in his researches. Realizing fully the need for a full catalog of this library, the Library Board has made the preparation of one fitted to act as a foundation for future work its chief task for the past two years. The variations in the catalogs of the four libraries that make up the Engineering Societies Library are being removed by the systematic recataloging now in progress, and at the same time the large accumulation of uncatalogued material is being made accessible.

All periodicals, including the transactions of societies, except a few of minor importance, are now fully catalogued. All books acquired during the past four years, and all older editions of these titles, have been handled.

As the new catalog begins to function, there is no doubt of its value or of its need. With less than three-quarters of the books completely analyzed, the efficiency of the library has increased in amazing proportions.

The Brussels classification is used. For example, in the subject of Railroads, it is not enough to know that there are books on locomotives, terminal stations, signals, road beds, rolling stock, etc.; the classifier must first realize that the two main divisions of this subject are the Engineering or Construction side, and the Transportation or Economic side, and that the literature on the subject will naturally fall in one of these groups. By the charting of subjects, the possibilities of the field are apparent. The accompanying chart is given as an example of the layout of a subject. It shows only the main groups. More specific divisions are used in practice.




RAILROAD CLASSIFICATION CHART.

The next step is to get at the correct subject of each book. This is frequently an easy task; the author has a definite purpose, he states his case and gives a comprehensive outline of his theme. Such books, including textbooks, histories and simple treatises, are not difficult to handle, but many books are so involved that much time and study must be devoted to them before subjects can be correctly determined. The classifier can never stop at the title page. Titles are misleading, and even an author's preface often gives an incorrect statement of what the book proposes to treat. Therefore the text of all books must be thor-

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oughly perused, and each one considered on its own merit, as well as in relation to like kinds, so that all treating of one subject may fall into the same group. Very often one title will contain splendid material on five, ten or twenty subjects.

Again, books are found to contain subjects quite foreign to each other. A work on the application of electricity to some special industry makes a contribution to both electricity and the industry, and may also contain a few excellent chapters on foreign trade.

Every book must be given a symbol by which it can be identified. If there are 150,000 books there must be as many symbols. A record of these symbols must be made, together with the author and title which they represent. This also serves as an inventory of the books as they stand on the shelves.

Every book has to be handled from 15 to 20 times after its receipt from the publisher before it is ready for the shelves. Most of these are mechanical processes, but at least two of them, the classifying and cataloging, are quite the reverse.

Lack of money has prevented the addition of some equipment which would speed up the work and also afford better facilities for using the catalog. A specially designed table is needed, to be placed in the reading room near the catalog, on which the more important published indexes could be placed and where readers could consult the catalog trays. This would bring card and book bibliographies together and facilitate consultation of the catalog.

Inadequate funds have also made it necessary to shelve hundreds of volumes of periodicals without binding, tied in volumes. This is a temporary measure, and when these volumes are to be bound they will have to be collected again. Until bound, the chances of loss and mutilation, of course, are great. Stress is laid upon this condition because the mechanical handling by the catalogers of long sets of magazines, often made up of 50, 75 or 100 volumes, has in great measure hindered the work.

It may be safe to say that the end is in sight, but it is impossible to tell how many months may elapse before the work is completed.

HARRISON W. CRAVER.

## Directors Meeting

AT THE executive session of the meeting of the Board of Directors held on Feb. 21, 1922, the following were present: Arthur S. Dwight, president; W. H. Aldridge, George D. Barron, William H. Bassett, Galen H. Clevenger, W. M. Corse, A. R. Ledoux, Edwin Ludlow, R. V. Norris, Charles F. Rand, J. V. W. Reynders, George Otis Smith and W. E. Wrather.

The following officers were elected: J. V. W. Reynders, first vice-president; Charles F. Rand, treasurer; Frederick F. Sharpless, secretary; Percy E. Barbour, assistant secretary.

Committees were elected as follows:

*Executive Committee.*—A. R. Ledoux, chairman; Arthur S. Dwight, Edwin Ludlow, Charles F. Rand and J. V. W. Reynders.

*Finance Committee.*—Walter H. Aldridge, chairman; George D. Barron and Galen H. Clevenger.

*Papers and Publications Committee.*—Sydney H. Ball, chairman; F. F. Sharpless, secretary; Percy E. Barbour, Galen H. Clevenger, B. B. Gottsberger, Henry D. Hibbard, Robert Linton, Paul D. Merica, R. V. Norris, George C. Stone, Chester W. Washburne, Arthur L. Walker.

President Dwight appointed the following Committee on Membership: E. De Golyer, chairman; William Young Westervelt, vice-chairman; William M. Corse, H. G. Moulton and C. Minot Weld.

After the executive session, an open session was held and, in addition to those mentioned above, there were present:

F. F. Sharpless, secretary; Percy E. Barbour, assistant secretary; L. K. Armstrong, H. B. Fernald, F. L. Garrison, W. Spencer Hutchinson, Oscar Lachmund, Robert Linton, Horace F. Lunt, W. E. McCourt, P. N. Moore, R. A. Parker, Maj. C. R. Pettis, U. S. A., F. W. Sperr, Arthur Thacher and W. Y. Westervelt.

The Board of Directors, desiring to record its appreciation of the arduous work of the various committees charged with the conduct of the 1922 annual meeting of the Institute in New York, unanimously adopted the resolution that was printed on page 16 of the March MINING AND METALLURGY.

The following dates, for meetings of the Board of Directors for the next eleven months were agreed upon: March 24, April 28, May 19, June 23, Sept. 22, Oct. 20, Nov. 17, Dec. 15, 1922 and Jan. 26, 1923.

A budget for the year 1922 was presented by the Finance Committee and adopted. The report of the Treasurer and Finance Committee was presented in writing, was accepted, and ordered filed.

President Arthur S. Dwight announced the appointment of John H. Janeway as member of Library Committee.

Actions of the Executive Committee were approved as follows: Authorization of Local Section at Kingman, Ariz.; election of 14 Members, 13 Associates and 26 Junior Associates; approval of change of Constitution of American Engineering Standards Committee.

The report of representatives on American Engineering Council for the year 1921 was approved.

Action on the report of the Joint Committee on Code of Ethics for Engineers was deferred until the next meeting.

Twenty-three Members, 9 Associates and 35 Junior Associates were elected to membership; two changes of status from Associate to Member, one from Junior Associate to Associate, and two from Junior Associate to Member; eight were reinstated to membership; the dues of one number were remitted for the years 1918 and 1919; 94 resignations were accepted.

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The Mining and Metallurgical Society of the University of Alabama was admitted as an Affiliated Student Society.

President Dwight was authorized to appoint a committee to coöperate with the War Department in the matter of Industrial Preparedness.

An invitation to the officers and directors to attend the annual meeting of the Canadian Institute of Mining and Metallurgy was referred to President Dwight with power. A committee composed of Bradley Stoughton, chairman, J. V. N. Dorr and R. B. T. Kiliani was appointed to attend this meeting.

## Significance of Standardization in America*

THE significance and importance of standardization to industry and to the Federal Government seem almost axiomatic to those of us who have been actively interested in standardization work for a number of years, and since the present is a particularly opportune time for the launching of extensive coöperation between government and industry, it seems well to point out the opportunities and means of such coöperation in industrial standardization.

Of the many advantages to be derived by both industry and the Government from standardization along national lines, the most important seem to be:

1. Mass production, with its obvious advantage to the producer, means reduction in cost. Competition engendered by such production insures to the consumer, including the Government, the benefit of reduction in price.

2. Elimination of wide varieties and sizes permits producers to concentrate on those retained, and facilitates improvements in method and equipment that will ultimately result in the elimination of waste and reduction of cost to the consumer, including the Government.

3. Putting all tenders on an easily comparable basis promotes fairness in competition in both domestic foreign trade, to the benefit of both producer and consumer.

4. Elimination of indecision in both production and utilization removes a prolific cause of inefficiency and waste.

5. Stabilization of production and employment means for the producer uninterrupted manufacture from stock during periods of depression. This is of vital interest to the Government as being of benefit to the country as a whole.

6. Accumulation of stock means prompt deliveries by the producer, and eliminates the necessity of the Government itself carrying a large inventory of material.

* Excerpts from paper presented before the Washington, D. C. Section of The American Society of Mechanical Engineers, Dec. 9, 1921, by A. A. Stevenson, chairman, 1921, American Engineering Standards Committee.

In both Great Britain and Germany, national standardization is being carried on intensively. For reasons for which neither can be blamed exclusively, there is no doubt that the industries of this country and the Government Departments in many instances have not coöperated in a way to insure best results in standardization along national lines. A recent event of unusual importance was the organization of the Federal Specifications Board, for unifying the specifications for all Government purchases, military as well as non-military.

In order that standardization along national lines may be brought about, it is necessary that there be some central body to act as a clearing house in standardization work. It is essential that there be brought together information concerning the organizations by which standards have been formulated and are being promulgated and details relating to such standards as are already in use. From the central body charged with the duty of collecting this information, it should be transmitted promptly wherever needed to insure the elimination of conflicts in the formulation of standards. Success to be expected from a central body organized for the purposes just stated obviously depends upon the authority invested in it, and the recognition received by it from the organizations throughout the country doing standardization work.

As a result of the work in which the American Engineering Standards Committee is now actively engaged, existing conflicting standards are being brought into harmony, and there are being created truly representative committees to formulate new standards. The methods employed obviously differ somewhat from methods utilized hitherto, and it must be acknowledged that they are not yet fully understood by many of the organizations in America that should be coöperating in standardization along national lines.

The real significance of standardization to industry and the Federal Government—what it may mean and what it can accomplish, will not be fully realized until there is sincere coöperation which is sympathetic, systematic and comprehensive, between industry and the Federal Government, in which coöperation the general consumer has a part.

## Last Words of Foolish Miners

THESE typical sayings are from the Miners' Safety and Health Almanac, issued by U. S. Bureau of Mines, Washington, D. C.

"I wonder if this is a live wire. I'll touch it and see."

"Cap crimpers are toys for kids; see me use my teeth."

"There comes the trip. Wonder if I can get across the track ahead of it."

"This must be a missed shot. I'll dig in and find out."

"I don't need a safety line; this is easy."

"This roof looks bad but I'll risk it."

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# Official Institute Reports for the Year 1921

## Abstract of Report of President

THE business depression has borne severely upon our members, and the shutting down of mines and metallurgical works has thrown so many of our younger members out of employment that we have not only had a great many resignations but also there are nearly 500 who, under the Constitution, should be dropped for non-payment of dues for two years; and further, nearly 1000 who have found it impossible to meet the call for dues during the past year. This has caused a severe drop in our revenue, which was partly covered by the 1200 new members who joined the Institute during the year, and by the generous reply to the appeal for a voluntary contribution made at the beginning of the year that brought nearly $18,000 into the treasury.

In spite of this, we are able to show for 1921 an excess of receipts over expenditures of $41,103.52, from which we have deducted the deficit on the books of the Institute of $3,178.74, closing the year with a net excess of $37,924.78, an amount sufficient to pay for the publication of all papers on hand and leave a cash surplus of over $7000.

Probably the greatest item of saving that was accomplished during the past year was in the cost of the magazine. A few comparative figures on this subject may be enlightening to some of our members. During the year 1919, we published the old bulletin at a cost of $55,000, with a revenue from advertising and sales of $18,000, making a net cost of $37,000. In 1920, MINING AND METALLURGY was started, and the cost for the first year was $41,000 with a revenue of $27,000, leaving a loss for the year of about $14,000. In 1921, the cost of MINING AND METALLURGY was $35,000, with a revenue of over $30,000, making a net loss for the year of only $4500, and the increasing amount of advertising makes it entirely probable that in the year 1922 the magazine will become entirely self-supporting. During my visits to the local sections on the Pacific Coast and in the interior, I found that the members of our Institute residing in the mining camps of the West look upon the magazine as the main tie with the Institute.

We have also economized in expenditures for our Increase of Membership Committee. In spite of the serious depression in all lines of mining business, our membership has had an increase of 1235 names during the past year, and, with the exception of the year 1920, it shows the greatest increase of membership of any year in the history of the Institute.

Three new local sections were organized during the year: Oregon, Philadelphia, and West Virginia and Eastern Kentucky at Charleston, West Va. Two other sections, at Tampico, Mexico, and Kingman, Arizona, have made application and been granted their request for authority to form sections and are now completing their organizations.

Another most interesting feature of the past year was the presentation of the John Fritz Medal to Sir Robert Hadfield in England and M. Charles Eugène Schneider in France by the John Fritz Medal Board, supported by a delegation of engineers from the four Founder Societies.

The power of the combined engineering talent of the country is needed to solve our present problems. The first essential is the completion by American engineers of the organization of the Federated American Engineering Societies, and the spread of that organization throughout the country. To accomplish this, our local sections should coöperate with the local sections of the other Founder Societies and should organize local engineering societies that can be formed into active members of the Federated Societies.

EDWIN LUDLOW.

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## Abstract of Report of Secretary

THROUGH the efforts and generous assistance of our members, MINING AND METALLURGY, during recent months, has shown constant improvement. For the year 1921, the net cost of the magazine was about fifty cents per member, per annum. Occasional letters are received criticizing the Board for producing this publication, but they are more than offset by letters of approval. When the full purpose of the publication is appreciated, criticism ceases.

The elimination of MINING AND METALLURGY and reversion to free distribution of all papers to all members, whether desired or not, would mean such a heavy additional expense that the number of papers would have to be much curtailed.

The generous coöperation of members in sending for only such papers as they particularly desired has saved the Institute thousands of dollars. A plan is being worked out that will materially assist in securing a prompt distribution to members of all pamphlets dealing with subjects in which they are especially interested.

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Thanks to the watchful care of the president, the Finance Committee, the support given to both by the Board, and to a generous voluntary contribution from many members, the deficit of a year ago has been wiped out and 1921 ends with a creditable balance on hand. Much of this apparent surplus, however, is earmarked for the payment of 1921 obligations. There is an accumulation of unpublished pamphlets, which it is hoped to get into the form of TRANSACTIONS early in 1922; the balance carried forward will probably enable this to be done.

The income for 1922 is uncertain in amount. Many of our members are out of employment and the earnings of still more are so small as to make even our small dues a burden. In view of the present depressed condition in the mining and allied industries, the Finance Committee has suggested a budget as small as possible consistent with the efficient operation of the Institute.

One of the most successful meetings ever held by the Institute was that of its 50th Anniversary, which was held at Wilkes-Barre, in September. The credit for the success of this meeting rests upon the members of the anthracite region and their able local chairman, R. V. Norris.

The following names have been added to the Honorary Membership roll during the year: William Cuthbert Blackett, Marshal Ferdinand Foch, Frank William Harbord, H. O. Hofman, C. McDermid.

We record with sorrow the passing of many prominent members of whom the following deserve special mention: B. B. Lawrence, who had served the Institute as manager, councillor, and vice-president; J. W. Richards, vice-president twice, councillor, and director; Stuart M. Buck, manager; and our honorary member, Prof. D. C. Tschernoff.

Since the report of the secretary for the year 1920, the Committee on Mining Methods has become very active, under the chairmanship of John E. Hodge.

In former days, much less thought was given to the younger members of the profession than is the case today. It is now realized that the students of today are the members of tomorrow and that the interest of the older members of the profession should be directed toward the younger members almost as soon as they start in our direction.

The record of the Employment Bureau, supervised by the four Founder Societies, for the year is enviable.

During 1921, 1905 applications for positions were received and it is known that 1365 men were placed, and probably many more who failed to notify the able manager, W. V. Brown, of their having obtained employment through the Bureau.

There is only one reason why more men have not been placed; lack of funds with which to work. It has cost the interested societies about $16,245 to place these men, and this sum is as large as the societies have felt that they could afford to devote to the work. A paid bureau has been considered, but so far no practical method of operating it has been found.

Those men who have secured employment could well afford to contribute for the benefit of those who have not, and yet there are certain disadvantages connected with a paid service; its apparent commercial aspect makes the plan questionable. The problem is not easy, and it is one of the most important confronting the members of the Institute who happily are not upon the list of the unemployed.

F. F. SHARPLESS.

## Report of Membership Committee

The number of applications for membership received in 1921 was 898. The number of persons elected was 1324, of whom 1284 accepted and became members. The total membership Dec. 31, 1921, was 10,205, as against 9323 on Dec. 31, 1920. The changes in membership during the year were as follows:

| | | |
|---|---|---|
| Total membership, Dec. 31, 1920 | | 9,323 |
| Elected and placed on rolls in 1921 | 1,251 | |
| Reinstated | 33 | 1,284 |
| | | 10,607 |
| Loss by resignation in 1921 | 196 | |
| Loss by death in 1921 | 88 | |
| Loss by suspension in 1921 | 118 | 402 |
| | | 10,205 |

This membership is distributed as follows:

| | |
|---|---|
| Honorary members | 19 |
| Members | 7,909 |
| Associates | 951 |
| Junior Associates | 1,326 |
| Total membership, Dec. 31, 1921 | 10,205 |

## Report of Library Committee

The library was used during the year by approximately 35,000 persons. Of these 26,840 visited it, the others referring to it by mail or telephone. The number of visitors was 12 per cent. greater than in 1920.

The accessions to the permanent collection were 4210 pieces; of these 414 were purchased, 3129 were gifts. The library contained, on Dec. 31, 1921:

| | |
|---|---|
| Volumes | 118,980 |
| Pamphlets | 34,091 |
| Maps and plans | 555 |
| Searches | 3,904 |
| Total | 157,530 |

Recataloging has been carried on as actively as funds permitted. Searches, translations, and photoprints have been made for 2342 persons. The library has continued to compile copy for the Mining and Metallurgical Index. Arrangements have been made to lend duplicate books to members of the Institute.

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## Financial Statement

As examined and approved by the Finance Committee and Board of Directors at their meeting on Jan. 27, 1922.

### Balance Sheet, as of Dec. 31, 1921, American Institute of Mining and Metallurgical Engineers, Inc.

ASSETS

| | | |
|---|---|---|
| Equity in U. E. S. land and building | | $486,792.79 |
| Books in the library | | 40,000.00 |
| Investments | | |
| James Douglas Fund | $ 99,999.36 | |
| R. W. Hunt Fund | 7,497.33 | |
| Life Membership Fund | 9,415.63 | 116,912.32 |
| Cash | | |
| should be invested | $ 2,950.33 | |
| in banks, general funds | 31,873.80 | |
| petty cash, in office | 1,050.00 | 35,874.13 |
| Suspense accounts | | 625.30 |
| Paper on hand | | 8,771.93 |
| Insignia on hand | | 185.34 |
| | | $689,161.81 |

LIABILITIES

| | | |
|---|---|---|
| Accounts payable | $ 4,180.13 | |
| | 391.46 | $ 4,571.59 |
| Due the James Douglas Fund | $100,000.00 | |
| Due the R. W. Hunt Fund | 7,500.00 | |
| Due the Hadfield Fund | 1,154.51 | |
| Due the Thayer Fund | 8.14 | |
| Due the Life Membership Fund | 11,200.00 | |
| Total of above | | 119,862.65 |
| Reserve for Life Memberships | | 40,000.00 |
| Surplus as follows: | | |
| Contributions by Carnegie and others to real estate | $486,792.79 | |
| Excess of cash receipts over payments Dec. 31, 1921 | 37,934.78 | 524,727.57 |
| | | $689,161.81 |

### Receipts and Expenditures for the Twelve Months Ending Dec. 31, 1921

RECEIPTS

| | |
|---|---|
| Dues, Arrears | $ 3,483.58 |
| Current | 98,505.81 |
| New members | 12,822.42 |
| In advance | 2,115.43 |
| Initiation fees | 10,583.00 |
| Voluntary subscriptions | 17,811.65 |
| Sale, Transactions | 4,057.57 |
| Binding | 8,976.69 |
| Magazine | 4,140.38 |
| Pamphlets | 562.15 |
| Indexes and Emmons | 267.05 |
| Pyrometry volume | 764.07 |
| Raymond volume | 33.00 |
| Year Book | 111.80 |
| Pins and fobs | 387.85 |
| Miscellaneous receipts | 174.03 |
| Advertising | 26,370.32 |
| Interest on bank balances | 1,070.25 |
| Life memberships | 442.17 |
| Douglas fund | 6,167.34 |
| | $198,846.56 |

EXPENDITURES

| | |
|---|---|
| Year Book | $ 4,043.41 |
| Magazine | 35,055.28 |
| Technical papers | 6,920.51 |
| Authors reprints | 198.40 |
| Transactions, Vols. 1 to 63 | 2,350.67 |
| Vols. 63 | 1,600.00 |
| Vols. 64 | 10,849.31 |
| Vols. 65 | 4,158.27 |
| Vols. 66 | 1,269.52 |
| Index and Emmons volume | 66.43 |
| Pyrometry volume | 486.77 |
| Raymond volume | 21.95 |
| Meetings | 2,891.09 |
| Local Sections | 2,645.25 |
| Technical Committees | 273.25 |
| Office space | 3,274.00 |
| Library | 9,249.96 |
| Federated Am. Eng. Societies | 12,660.22 |
| Amer. Engr. Standards Committee | 1,500.00 |
| Salaries not otherwise distributed | 34,428.89 |
| Accounting Department | 7,954.83 |
| Membership Department | 3,795.28 |
| Stationery and supplies | 2,922.12 |
| Telephone and telegraph | 1,525.34 |
| Postage for general office mail | 2,054.20 |
| Furniture and fixtures | 1,674.69 |
| Miscellaneous office expenses | 581.48 |
| Secretary's traveling | 959.85 |
| President's traveling | 720.38 |
| Legal expenses | 325.00 |
| Miscellaneous Institute expenses | 1,057.73 |
| Pins and fobs purchased | 228.98 |
| | $157,743.04 |

## Report of the Committee on Papers and Publications

During the year 1921, 138 papers were submitted to the committee. Of this number 71 were accepted for presentation at a meeting of the Institute, 42 were declined, 13 were accepted for publication only in MINING AND METALLURGY, and 12 were returned to the authors by request or for revision. The principal papers have been printed in full and abstracts of all the papers were printed in MINING AND METALLURGY.

The papers presented at the New York meeting may be classified as follows: iron and steel, 9; mining and milling, 4; non-ferrous metallurgy, 5; Institute of Metals Division, 2; coal, 7; petroleum and gas, 6; industrial relations, 2; geology, 2.

For the meeting, in Wilkes-Barre, 45 papers were submitted, of which 24 were accepted and printed. In addition, 9 papers were presented at the Americanization session and four papers published by the Society of Economic Geologists were presented at the joint sessions with that society. Most of the papers presented at this meeting dealt with coal.

During the year, there have also been printed Volumes LXIV and LXV, and Volume LXVI is ready to be sent to the printer.

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# Local Sections and Affiliations

## Pennsylvania Anthracite Section is Active

THE Pennsylvania Anthracite Section had a very enthusiastic meeting on Feb. 4. D. C. Ashmead's paper, "Can Anthracite Mines be Operated Profitably on More than One Shift?" was presented and was discussed by the 52 members who were present.

George Stevenson, of Scranton, spoke on licensing of engineers, and William Griffith gave a talk on the consumption per capita of anthracite coal in large cities and rural districts. He showed that as the differential in price between anthracite and bituminous increases, the consumption per capita decreases.

## Institute of Metals Division

AT THE annual business meeting of the Institute of Metals Division, held on Feb. 21, 1922, the secretary, W. M. Corse, made a short informal report, saying that the membership of the Division runs well toward the thousand mark at the present time, and that the next meeting, to be held in conjunction with the American Foundrymen's Association, will be held in Rochester during the week of June 5, instead of in Cleveland in April.

The election of officers, which takes place every second year, resulted as follows: chairman, William B. Price; vice-chairman, George K. Elliott; secretary and treasurer, William M. Corse; members of executive committee, George K. Elliott, William Campbell, H. M. Lane, J. A. Capp, C. T. Bragg, E. E. Thum, Lawrence Addicks, W. A. Cowan, George F. Comstock, H. M. Williams.

## Copper as Well as Oil Discussed by Mid-Continent Section

THE regular monthly meeting of the Mid-Continent Section (formerly the Tulsa Section) was held on Feb. 24, with a good attendance. Two very interesting papers were given.

V. H. Hughes, petroleum geologist, gave a brief talk on The Conservation of Oil and Gas, in which he described the enormous waste of gas in the Oklahoma fields in the past and, also, some of the waste that is going on at the present time. He said that when the Cushing development was at its height over 500 million cubic feet of gas went to waste every day, and that this gas had a high gasoline content. He called attention to several of the fields in Oklahoma that are being drilled into water, and discussed methods by which this could be prevented.

Herbert G. Officer, who has spent about six years in Chile as head of the exploration work for the Anaconda Copper Mining Co., gave a paper on The Copper Mining Industry of Chile, illustrated by charts and maps. The following properties were discussed in detail: Chuquicamata, Potrerillos, Santiago Mining Co., and Braden mines. The magnitude of the industry in Chile was especially stressed. Mr. Officer said: "The total ore reserves are over 1200 million tons of 2 per cent. copper content. With an 80 per cent. metallurgical recovery, this would give 38,400 million pounds of copper available for market. The ore reserves of the seven American porphyry coppers (Utah, Nevada, Chino, Ray, Miami, Inspiration and New Cornelia) are about 800 million tons of 1.5 per cent. copper ore. With a recovery of 25 lb. per ton, there would be 20,000 million pounds of copper available for market. In other words, the American owned mines of Chile have 1.9 times as much tonnage and twice as much recoverable copper as the seven great "porphyry" mines in the United States. Of course we have other large resources, such as Lake Superior, Butte, Bisbee, and other mines, but these figures point to the day when Chile will once again lead the world in the production of copper. The present productive capacity of the United States is about two billion pounds per year. When the present plans are completed, Chile will be producing about one billion pounds of copper per year."

Two weeks before, on Feb. 11, the Mid-Continent Section took part in the entertainment of Dean Cooley, president of the Federated American Engineering Societies. The officers of all the local sections of the engineering societies represented in the F. A. E. S. gave a breakfast for Dean Cooley in the Hotel Tulsa; there was a luncheon at the City Club, and a banquet in the evening at the Hotel Tulsa. About 130 members attended the banquet. Alf. G. Heggem was toastmaster and M. M. Valerius had charge of all arrangements. Dean Cooley's visit was thoroughly enjoyed by all who had the pleasure of meeting him.

The meetings of the section are held regularly, the

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last Friday of each month, in the Y. M. C. A. at Tulsa, and plans are being laid to have some very interesting programs presented at the next four meetings. An outline of the program for these meetings will be printed in MINING AND METALLURGY.

## Mining Law Revision

THE subject before the San Francisco Section at its meeting on Feb. 14 was The Proposed Changes in the Mining Law of the United States. William E. Colby was the speaker of the evening. He treated the subject under three heads: the good points, the doubtful points, and the bad points of the new law. After the formal address, Mr. Colby answered questions and there was general discussion.

## Affiliated Student Societies

**University of Minnesota.**—The School of Mines Society is especially interested in the new building that is being erected on the campus. This building will

ARCHITECT'S PHOTOGRAPH OF THE MINES EXPERIMENT STATION BUILDING BEING ERECTED ON THE CAMPUS OF THE UNIVERSITY OF MINNESOTA.

house the Mines Experiment Station of the University of Minnesota and the North Central Experiment Station of the U. S. Bureau of Mines. It is expected to be the best laboratory in the world for the study of iron and manganese ores.

At the first meeting of the society in January, Roger W. Gannett, '18, spoke on Geological Exploration in Indo-China. Mr. Gannett recently returned from Yunnan Province, in southern China, where he spent considerable time making a survey of the mineral resources of the region. He explained in detail the methods used in reopening for examination the old Chinese workings on the lead-silver deposits, and discussed the geology of the ore-bearing formations.

The following meeting was addressed by Lyndon L. Foley, '18, who has been engaged for several years in an examination of oil possibilities on the island of Trinidad. Mr. Foley illustrated his lecture with slides, and outlined some of the obstacles under which exploration work is carried on in a tropical country.

On Feb. 11, E. J. Schrader, '05, spoke of the problems of reopening abandoned mines for examination and possible operation. At the following meeting, Mr. Schrader spoke on General Cyanidation Practice, outlining the ideal conditions under which the cyanide method would be most efficient, and explaining the ways in which actual conditions could vary from the ideal without encountering prohibitive losses and increased costs.

**University of Alabama.**—The students in mining and metallurgy have organized a society called the Mining and Metallurgical Society, which has a membership of 25 and includes not only students of mining and metallurgy but other students who are interested. The officers are: T. W. Newton, president; J. B. Martin, secretary.

The object of the association is to promote fellowship among the members and the discussion of current mining and metallurgical topics and literature. Meetings are held twice a month, at which papers are presented by prominent mining men and members of the faculty and also some of the student members.

**Montana State School of Mines.**—The Mining Society elected officers on Feb. 16, 1922. Ellis P. Frink is president; Wallace Lee, vice-president; William A. Scarlett, marshall; Alex. M. McDonald, secretary.

The society voted to change its name to The Anderson-Carlyle Technical Society, in honor of two men from the school who lost their lives in the World War.

## Annual Meeting of the Woman's Auxiliary

THE sixth annual meeting of the Woman's Auxiliary to the A. I. M. E. was held in New York, on Feb. 22, with Mrs. Arthur S. Dwight, the president, in the chair. In her address of welcome, Mrs. Dwight reviewed the life of the Auxiliary, speaking of it as a child which until now had been doubting and uncertain but which is now strong and sturdy enough to stand upon its own feet.

Formed in 1917, the Auxiliary was faced with war work almost from its beginning, and accomplished much. The General Council early saw the necessity for local sections, and today, the New York, Anaconda, Butte, Canada, Denver, Los Angeles, Northern California, St. Louis, Utah and Washington, D. C., local sections have duly elected representatives on the Board of Directors of the Auxiliary. Mrs. Dwight emphasized, however, that:

1. Work by separate sections, while necessary to *their* life, does not constitute organization for the Auxiliary.

2. Work undertaken by the whole Auxiliary can be the means of bringing about a strong organization.

3. Such work must be national in character and continuous in operation.

Mrs. Dwight reported that the Council, which hereafter is to be called the Board of Directors, has held nine regular meetings and one special meeting. Mrs. Eilers, the treasurer, reported a balance of $683.61 on hand Feb. 1, 1922.

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Mrs. Sidney J. Jennings, chairman of the Executive Committee of the Educational Fund, reported that the contributions to the fund for 1921 amounted to $1358.50, of which 25 per cent. is invested in a permanent endowment fund for engineering education. If the Auxiliary desires to appoint a beneficiary each year for a four-year course it will be necessary to secure a larger number of contributors.

Mrs. Jennings also mentioned the scholarship offered by Columbia University which was described in the February number of MINING AND METALLURGY, pp. 3 and 78. Mrs. Huntoon, treasurer of the Educational Fund, reported a balance of $2200.61 on hand on Feb. 21, 1922.

Mrs. Hoover, chairman of the Membership Committee, reported that 2200 cards of invitation to join the Woman's Auxiliary had been sent out and that a membership list was published on Jan. 1, 1922 and 1068 copies were mailed to members of the Auxiliary.

Mrs. F. F. Sharpless, chairman of the Press Committee, asked for regular and full reports of the work of the local sections.

The Committee on Revision of the By-laws, Mrs. W. Y. Westervelt chairman, reported that few changes were necessary, it being rather the work of the committee to amplify certain points and to correlate and make more available for use certain others—also especially to provide for the Educational Fund Committee which has become so important a branch of the work.

The local section reports were read, either by the women acting as proxies, or by members of the sections.

Mrs. J. B. Tyrrell, of Toronto, read the report of the Toronto Branch of the Association of Women of the Mining Industry of Canada, which was organized on Feb. 28, 1921, as the result of a suggested section of the Woman's Auxiliary to the A. I. M. E. in Canada. There was a general feeling that the woman's organization in Canada should be connected with the Canadian Institute of Mining and Metallurgy, rather than with the A. I. M. E., and also that something a little broader than the Woman's Auxiliary was needed, broad enough to include all women connected with the mining industry in any way.

The Association of Women of the Mining Industry of Canada has a three-fold object: to promote social intercourse among the women of the mining industry; to render service to all connected with the industry; and to encourage coöperation in work for the benefit of the community and the country at large in all that pertains to the interests of the industry.

The Chicago Section, through Mrs. Luther V. Rice, its chairman, and the Colorado Section, of which Mrs. Leonard is director, reported active interest and regular attendance at meetings.

The St. Louis Section, Mrs. Glasgow, director, has held three successful meetings during the year. Mrs. Newton R. Wilson, the treasurer of this section, has made a gift of $2900 for a scholarship at the School of Mines at Rolla, Mo., in the name of the St. Louis Section of the Woman's Auxiliary.

The Anaconda Section, Mrs. F. S. Adams, director, has expended $1929.07 in supplying milk to needy children and has raised money by dues, donations, teas and drives to contribute to the Educational Fund of the Woman's Auxiliary, the Montana Orphans' Home at Helena, the Anaconda Salvation Army Christmas Dinner Fund. The section helped to prepare the Municipal Christmas tree and made donations of gifts for 2000 children.

The Butte Section, Mrs. H. T. Mann, director, has contributed to the national organization, to the 1921 Hoover Fund, to the Charity Fund of the Neighborhood Committee, to the Auxiliary Educational Fund, and to the National Relief Council; a total of $222.90. The Butte Section has conducted a kindergarten in the public school of the foreign district, and a sewing school for girls. The section has found and taken care of a number of needy persons. Funds are being raised through social gatherings, but the chief funds for charitable work in Butte are provided from a Community Chest, each man having work in Butte contributing one day's pay per month. For each dollar donated by individuals the mining companies are donating a dollar and a half. The total fund has amounted to more than $50,000. The members of the Butte Section are working with the board of investigators and distributors of these funds.

Mrs. D. M. Liddell reported that the New York Section has done some work for engineers in the Fox Hills Hospital and various members have worked at the Service Clubs for ex-service men. The section has contributed $126 to the Educational Fund.

The Northern California Section was reorganized on Jan. 27, 1922, and is to be known as the San Francisco Section. Mrs. Edmund Jüssen is director.

Mrs. Philip Wiseman, director, made a very full report of the work of the Los Angeles Section. The monthly meetings were carried throughout the year, with the exception of July and August which were combined and celebrated by a picnic at Santa Monica. Talks have been given by members of the section, on mining districts in Africa, South America, Alaska, Mexico, Burmah, Russia and New Zealand.

Early in the spring the section answered a call from the Red Cross for garments for the Near East Relief; 195 new garments were made and enough good, useful, second-hand ones, donated by members, brought the contributions up to 300 garments. This section pledged $150 to the Educational Fund.

Mrs. R. C. Gemmell, director, and Mrs. Edward R. Zalinski, secretary, reported that the Utah Section is broadening. The Vacation Fund sends one or two working girls to the mountains during July and August. Last summer the members made children's garments for needy families in the camp at Bingham. An

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entertainment is given each year to provide a subscription for the Educational Fund.

The Washington Section has not yet specialized in any work but has lent a helping hand to many. One of the members obtained a scholarship in geology for a young Russian stranded in this country. The section outfitted him and gave him a check for one hundred dollars. At Christmas, the section sent a donation to the Anaconda Section, and distributed clothing to the poor in Washington through the agency of the Juvenile Court. The secretary of the section, Mrs. Mulliken, wishes to establish a circulating library among mining camps, and already has nearly a hundred books. This section has also contributed to the Educational Fund.

After the section reports were completed, a vote of thanks was extended to Mr. and Mrs. Ludlow for their reception to the members of the Auxiliary and their guests, at the Ambassador Hotel on Feb. 20. A vote of thanks was also extended to Mrs. Barron for the luncheon and card party given the members of the Auxiliary who visited her home on Feb. 21.

The tellers reported the following elections for the year 1922: president, Mrs. H. W. Hardinge; first vice-president, Mrs. H. P. Henderson; second vice-president, Mrs. J. A. Church, Jr.; third vice-president, Mrs. W. Y. Westervelt; secretary, Mrs. J. V. W. Reynders; treasurer, Mrs. Karl Eilers.

At the afternoon session, Alexander Black entertained the Auxiliary by a short speech on the subject of "The Latest Thing."

On the other days of the annual meeting, the ladies shared the general entertainments provided for members of the Institute. On Monday morning, visiting ladies were shown some of the interesting sights of the city, and on Monday evening they enjoyed a theater party, while the Institute members were indulging in a smoker.

# Increase of Membership Department

**Total membership as of March 11, 1922, is 10,174**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period Feb. 18 to March 20, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—George Huntington Clark,** Birmingham, Ala.
Present position: Consulting Engineer, Assistant to State Geologist, Alabama Geological Survey.
Proposers: W. R. Crane, W. J. Penhallegon, T. H. Aldrich.

**2—Murray Nicholas Colman,** Atolia, Cal.
Present position—1921 to date: Metallurgist, California Rand Silver, Inc.
Proposers: Abbot A. Hanks, F. W. Bradley, David Atkins.

**3—E. F. Coste,** Dallas, Texas.
Present position: Manager, Eugene Coste and Co., Petroleum Engineers and Geologists.
Proposers: Eugene Coste, David White, David T. Day.

**4—Charles Prosper Dampman,** Philadelphia, Pa.
Present position: Supervisor, Fuel Conservation, Ph ladelphia and Reading System.
Proposers: S. M. Vauclain, D. B. Wentz, L. H. Taylor, Jr.

**5—Ira F. Davis,** Dorothy, W. Va.
Present position—1920 to date: General Manager, Fuel Mine Operations, Cleveland and Ohio Railway Co., Richmond, Va.
Proposers: William N. Page, Charles E. Krebs, James M. Clark, Carl Scholz.

**6—Somerville H. Eastment,** Philipsburg, Pa.
Present position—1920 to date: General Superintendent, Cedar Hill Coal Mining Co., Caswin Coal Mining Co., Brighton Coal Mining Co., Osceola Mills, Pa.
Proposers: Hugh Archbald, G. F. Dunkle, Richard H. Vail.

**7—Glenn G. Gentry,** Aspen, Colo.
Present position—1921 to date: Mill Superintendent, Silver Mines Co. of America.
Proposers: Stuart Croasdale, J. T. Boyd, Lewis G. Rowand.

**8—Carlos Edmund Holley,** Mancelona, Mich.
Present position—1920 to date: Mechanical Engineer for Autrim Iron Co.
Proposers: F. W. McNair, W. E. McRandle, J. B. Cunningham.

**9—William K. Kirby,** Golden, Colo.
Present position: Professor of Petroleum Engineering, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, Victor C. Alderson.

**10—Irvine Meredith Marshall,** Iron Mountain, Mo.
Present position—1921 to date: Mining Engineer, Iron Mountain Co.
Proposers: T. J. Mateer, S. D. Robinson, R. F. Taylor.

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**11—William Rutherford Minds,** Ramey, Pa.
Present position—1894 to date: Superintendent, Bulah Coal Mining Co., Ramey, Pa. and New York, N. Y. Bulah Shaft Co., Ramey, Pa. (all affiliated).
Proposers: J. S. Sommerville, W. A. Jones, H. H. Morris.

**12—Russell S. Mitchell,** East Brady, Pa.
Present position: Superintendent, Kaylor Mines, Pittsburgh Limestone Co.
Proposers: Ralph E. Larry, V. M. Frey, Joseph T. Singewald, Jr.

**13—Willard F. Rhodes,** Los Angeles, Cal.
Present position—1921 to date: Associated with T. E. Mitchell in concrete research work and construction.
Proposers: T. E. Mitchell, M. W. Bacon, Harry V. Croll.

**14—William Roy Ridge,** Santa Monica, Cal.
Present position: Non-active in mining, developing oil lands in Louisiana.
Proposers: Thomas Warner, W. A. Newman, H. C. Morris.

**15—John Clark Ross,** Tulsa, Okla.
Present position—1920 to date: Geologist, Twin State Oil Co.
Proposers: Walter L. Dobie, R. S. McFarland, L. Murray Neumann.

**16—Ernest Henry Somerset Sampson,** Goyllarisquisga, Peru, S. A.
Present position—1920 to date: Coal Mine Survey, Cerro de Pasco Copper Corpn., Coal Mining Department.
Proposers: R. H. Allport, F. W. Collins, M. McDermid.
Endorsed by: The Institution of Mining and Metallurgy.

**17—Duncan Smith,** Bruxelles, Belgium.
Present position—1914 to date: Head of Mission for Exploration and Operation in Belgian Congo.
Proposers: C. A. Burdick, S. H. Ball, E. W. Engelmann.

**18—Harry Sordy,** Merlin, Ore.
Present position—1921 to date: Superintendent, Almeda Mines Co.
Proposers: Carl N. Anderson, Alva H. Gunnell, Henry M. Parks.

**19—Henricus Johannes Stander,** Wilmington, Del.
Present position: Flotation Engineer in charge of liquid products, Hercules Powder Co.
Proposers: Charles F. Willis, G. M. Butler, T. G. Chapman

**20—Edgar G. Willrich,** Tulsa, Okla.
Present position: Consulting Practice, Member of firm Cochrane, Willrich and Johnson.
Proposers: Victor H. Cochrane, John M. Lovejoy, R. S. McFarland.

**21—Deane Jackson Wolff,** Wichita, Kansas.
Present position—1920 to date: Geologist, National Refining Co., Cleveland, O.
Proposers: Herman J. Allen, Marvin Lee, Frank Carney.

### Associates

**22—Cunningham Le Roy Griffith,** Tampico, Mexico.
Present position—1920 to date: Geologist, La Espuela Oil Co., S. A.
Proposers: A. N. Winchell, E. F. Bean, H. R. Aldrich.

**23—George M. Humphrey,** Cleveland, O.
Present position: Partner, M. A. Hanna & Co.
Proposers: H. S. Stebbins, L. E. Dunham, C. N. Hickok.

**24—J. Everts Lamar,** Urbana, Ill.
Present position: Assistant Geologist, Illinois State Geological Survey.
Proposers: F. W. DeWolf, Harold E. Culver, James H. Hance.

**25—Crispin Oglebay,** Cleveland, O.
Present position: Chairman of the Board, Ferro Foundry & Machine Co.; General Manager, Oglebay Norton & Co., Agents.
Proposers: R. C. Allen, P. S. Williams, W. O. Hotchkiss.

**26—Howard Peck Smith,** Leonia, N. J.
Present position: Assistant Mechanical Engineer, Joseph Dixon Crucible Co., Jersey City, N. J.
Proposers: A. L. Haasis, Alex. C. Humphreys, Carl B. Peters.

**27—William Ambrose Ward,** Tampico, Mexico.
Present position: General Manager, English Oil Co., S. A. of Tampico.
Proposers: Rex Townsend, Paul Weaver, K. C. Stadtmueller.

### Junior Associates

**28—Claude Allen,** Butte, Mont.
Student, State School of Mines, Butte, Mont.
Proposers: Earl B. Young, Horace T. Mann, Theodore Simons.

**29—Clifton Thorne Barker,** Excelsior, Minn.
Student, Minnesota School of Mines.
Proposers: Peter Christianson, Walter H. Parker, W. R. Appleby.

**30—August F. Beck,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: R. J. Grant, James Underhill, J. C. Robert.

**31—Paul Frederick Boswell,** Stanford University, Cal.
Student, Stanford University.
Proposers: W. F. Dietrich, Theodore J. Hoover, Welton J. Crook.

**32—Isaac Griffith Brown,** State College, Pa.
Student, Pennsylvania State College.
Proposers: D. F. McFarland, William R. Chedsey, E. S. Moore.

**33—John Hale Clopton,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. D. Aller.

**34—Richard Hudson Clough,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**35—William Phillips Crawford,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. M. VanTuyl.

**36—Frederick A. Dencer,** Champaign, Ill.
Student, University of Illinois.
Proposers: Ray W. Arms, A. E. Drucker, H. H. Stoek, Arthur J. Hoskin.

**37—Cecil Drake,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, Victor C. Alderson.

**38—Timothy Holland Driscoll,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Theo. Simons, H. T. Mann, A. E. Adami.

**39—William Godwin,** Pinckneyville, Ill.
Student, Missouri School of Mines, Rolla, Mo.
Proposers: C. R. Forbes, C. L. Dake, J. R. Guiteras.

**40—Robert J. Hendricks,** Wallace, Idaho.
Student, University of Washington.
Proposers: Rush J. White, Fred W. Callaway, L. K. Armstrong, John C. Semple.

**41—Arthur L. Herman,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, A. Henry Fretz.

**42—James Edwin Jewell,** Kansas City, Mo.
Student, Missouri School of Mines.
Proposers: C. L. Dake, C. R. Forbes, J. R. Guiteras.

**43—Byron Albert Chapman Johnston,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, H. B. Pulsifer.

**44—Walter Richard Landwehr,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Horace T. Mann, Theodore Simons, A. E. Adami.

**45—William Norman McBride,** State College, Pa.
Student, Pennsylvania State College.
Proposers: D. F. McFarland, William R. Chedsey, E. S. Moore.

**46—John Upton McFadden,** Philadelphia, Pa.
Student, University of Pittsburgh.
Proposers: H. B. Meller, E. G. Hill, Robert M. Black.

**47—William Carlton McKenzie, Jr.,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, T. M. VanTuyl, J. J. Lillie.

**48—Charles Bayard Mitchell, 2nd,** Woodbury, N. J.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, Augustus Henry Fretz.

**49—Gregg M. Moga,** St. Paul, Minn.
Student, Minnesota School of Mines.
Proposers: W. R. Appleby, E. H. Comstock, Walter H. Parker.

**50—James Jackson Naughton,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Horace T. Mann, A. E. Adami, Earl B. Young.

**51—Charles William Nelson,** Pittsburgh, Pa.
Student, Carnegie Institute of Technology.
Proposers: Charles R. Fettke, Edward Steidle, Robert Z. Virgin.

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**52—John Wilfred Patterson,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, F. M. Van Tuyl, J. J. Lillie.

**53—John B. Robinson,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, H. B. Pulsifer, Benjamin L. Miller.

**54—Joe S. Roper,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. M. Van Tuyl.

**55—Sidney E. Ross,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, Victor C. Alderson.

**56—Edward Patrick Shea,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: H. T. Mann, Theo. Simons, A. E. Adami.

**57—Thomas C. Smith,** State College, Pa.
Student, Pennsylvania State College.
Proposers: Everett W. Smith, A. M. Rodgers, D. F. McFarland.

**58—Thomas Hodgson Stubbs,** West Chester, Pa.
Student, Massachusetts Institute of Technology.
Proposers: Charles E. Locke, Carle R. Hayward, Edward E. Bugbee.

**59—Donald Samuel Tedford,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**60—Victor Theodore Thoeni,** Wykoff, Minn.
Student, Minnesota School of Mines.
Proposers: W. R. Appleby, E. H. Comstock, Walter H. Parker.

**61—Frederick Henry Villaume,** New York, N. Y.
Student, School of Mines, Columbia University.
Proposers: Robert Peele, R. M. Raymond, E. J. Hall.

**62—Paul Franklin White,** State College, Pa.
Student, Pennsylvania State College.
Proposers: William R. Chedsey, E. S. Moore, D. F. McFarland.

**63—J. Byron Wilson,** Minneapolis, Minn.
Student, Minnesota School of Mines.
Proposers: W. R. Appleby, E. H. Comstock, Walter H. Parker.

**64—Lyall Westley Zickrick,** Seattle, Wash.
Student, University of Washington.
Proposers: Joseph Daniels, Milnor Roberts, C. R. Corey.

**Change of Status—Associate to Member**

**65—Leopoldo Alcaraz Faustino,** Washington, D. C.
Present position—1921 to date: Assistant Chief, Division of Mines, Bureau of Science, Manila, P. I.
Proposers: William J. McCaughey, D. J. Demorest, H. E. Nold.

**66—Richard Raymond Smith,** Pulacayo, Bolivia, S. A.
Present position: Assistant Chief Engineer, Compañia Huanchaca.
Proposers: Roger T. Pelton, Harry M. Ziesemer, Le Roy B. Mitchell.

**67—Frederick Gale Tryon,** Washington, D. C.
Present position: Mineral Geographer, and Geologist, U. S. Geological Survey. In charge coal and coke statistics.
Proposers: George Otis Smith, G. F. Loughlin, David White.

**68—William Harrison Whittier,** Cartagena, Colombia, S. A.
Present position: Geologist for the Bataafsche Petroleum Maatschappy in South America.

**Change of Status—Junior Associate to Member**

**69—Enrique Juan Benoist,** Vina del Mar, Chile, S. A.
Present position: Engineer and Manager of Cia. Minera del Guanaco, Tal-Tal.
Proposers: Carl Edward David, Frank R. Van Horn, Zay Jeffries.

**70—Max Mueller Dixon,** Brooklyn, N. Y.
Present position: Geological work at Columbia University.
Proposers: R. J. Colony, J. F. Kemp, J. J. Galloway.

**71—John Stone Hoffmann,** Leon, Iowa.
Present position: Unemployed.
Proposers: Minard K. Shaler, Charles W. Boise, F. Van Brée.

**72—Dwight Lewis Sawyer,** Sneffels, Colo.
Present position—1921 to date: Geologist, Minas de Matalhambre, Province Pinar del Rio, Cuba.
Proposers: Charles A. Chase, Fred Carroll, James M. Hyde.

# Engineering Societies Library

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## Book Notices

**Automotive Repair.** By J. C. Wright. Vol. 1. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 530 pp., illus., diagrs., 9 × 6 in., cloth, $3.50.

For the repairman or owner who is expected to make general repairs and keep a car fit for operation. One hundred and eighteen jobs are given, with complete instructions; divided into chassis, engine, electrical, body and radiator work and "trouble shooting." They cover 95 per cent. of the problems encountered. The second section of the book presents the theoretical and mechanical information required to understand the construction and operation of the automobile.

**Burning Liquid Fuel.** By William Newton Best. (Revised edition.) N. Y., U. P. C. Book Co., Inc., 1922. 341 pp., illus., diagrs., 9 × 6 in., cloth $4.

Revised and enlarged edition of Dr. Best's book, formerly entitled the "Science of Burning Liquid Fuel." A plain, straightforward summary of long practical experience in designing and erecting oil fuel installations. Specific information is given upon the use of liquid fuel in many industries and upon all the various forms of equipment. Drawings show how the equipment is applied to various purposes. The book discusses locomotive, stationary, marine and low-pressure boiler equipment; practice in foundries and forge shops; equipment for the sugar, copper, ceramic, cement, baking, candy and oil industries, etc.

**Chemistry of Colloids.** By W. W. Taylor. Second edition. Lond., Edward Arnold & Co.; N. Y., Longmans, Green and Co., 1921. 332 pp., diagrs., 7 × 5 in., cloth, $3.50.

Discusses the general properties of colloids, methods of preparation, absorption and applications of colloid chemistry in dyeing, tanning, sewage purification, biology, etc. Intended as a convenient textbook and to serve as a reference work for workers in other sciences who are interested in colloids.

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**Coal Catalog, Combined with Coal-field Directory, for 1922.** Pittsburgh, Keystone Consolidated Publishing Co. 1350 pp., illus., 12 × 9 in., cloth, $10.

The first section discusses the geology of coal; the coal areas of the United States; the preparation, storage, sampling and composition of coal. It gives a table showing the fusibility of coal ash by states and seams, a list of coke ovens, a list of coal exchanges and pools with their mines, and a table of analyses of coal. Part 2 classifies coals according to rank, use and structure. Part 3 lists the mines of the country, by states, giving their situations, officers, equipments, output, etc.

**Deep Well Drilling.** By Walter H. Jeffery. Toledo, O., W. H. Jeffery Co., 1921. 531 pp., plates, illus., diagrs., tables, 9 × 6 in., cloth, $5.

Deals with the two methods generally used, the cable tool and the hydraulic rotary, including the building of the derrick, drilling, handling casing, fishing out tools and the completion of the well, according to the best practice of the day. Supplementary chapters deal with oil and gas geology, cost of drilling, strength of materials, laws relating to gas and oil wells and other general information of use to the driller.

**Étude Géométrique des Transformations Birationnelles et des Courbes Planes.** By Henri Malet. Paris, Gauthier-Villars et Cie, 1921. 259 pp., diagrs., 10 × 7 in., paper. 32 fr.

A study, by synthetic methods, of birational transformations and plane curves. It strives particularly to establish the first principles and to set forth precisely, in logical and geometrical fashion, the conditions under which the homographic correspondence of laws is based. The exposition of modern geometry is based on the methods of Chasles and Poncelet.

**Die Flussmetalle im Brückenbau.** By E. J. Albrecht. Leipzig, Wilhelm Engelmann, 1914. 56 pp., illus., 11 × 7 in., cloth. (Gift of the author.)

A concise history of the introduction of mild steel as a material for bridges, with some notes on the influence of steel on bridge design and construction. The introductory chapter gives an account of the development of iron making up to the introduction of the Bessemer and open-hearth processes. The second chapter records the introduction of steel bridges in different countries, the growth of testing methods and the use of alloy steels.

**The Foreman and His Job.** By Charles R. Allen. Phila. and Lond., J. B. Lippincott Co., 1922. 526 pp., 8 × 5 in., cloth, $3.50.

This book has grown from the experience of the author in organizing and conducting conferences of foremen, called to discuss matters that affect the efficiency of their work. It deals with the problems that confront the foreman and suggests proper ways to deal with them. The book is intended for foremen and other minor executives and also for organizers of foremen's conferences, who will find it a suggestive guide in arranging programs.

**Ingenieur-Mathematik.** By Heinz Egerer. Bd. 2. Berlin, Julius Springer, 1922. 713 pp., 9 × 6 in., cloth. 528 M.

The author has endeavored to present the subject in a manner that will give the engineer a thorough grounding in the branches that he will find useful in his work, and that will enable him to think and feel mathematically in later years, when most mathematical formulas are forgotten.

Volume 1, on algebra, analysis, etc., appeared several years ago. The present volume treats of differential and integral calculus, series, curves, maxima and minima. A third volume is in preparation.

**Hydroelectrical Engineering.** By Richard Muller. New York, G. E. Stechert & Co., 1921. 431 pp., diagrs., 10 × 7 in., cloth, $6.

A systematic exposition of those principles of hydraulic and electrical engineering which underly the design of hydroelectric plants. Intended for engineers engaged in designing and constructing plants or reporting on their commercial possibilities.

**Introduction to the Theory of Relativity.** By L. Bolton. N. Y., E. P. Dutton and Co., 1921. 177 pp., 8 × 5 in., cloth, $2.

This is, to a large extent, Mr. Bolton's essay on Relativity and Gravitation, which won the Eugene Higgins prize, extended to some twelve times its length. The book forms a simple introduction to the new general theory of mathematical physics, showing that this develops easily and naturally out of the search for a general mode of statement of physical laws. The author has bent his efforts specially to making the reader understand the general drift of the principle of relativity, to realize what it is all about.

**Management of Accumulators.** By Sir David Salomons, Ninth edition. Lond. and N. Y., Sir Isaac Pitman & Sons. Ltd. 178 pp., illus., 7 × 5 in., cloth. $3.

Earlier editions have appeared as the first volume of "Electric Light Installations and the Management of Accumulators." This edition gives a general survey of the construction, management and use of storage batteries, adapted to use by owners and users. Particular attention is given to the technique of charging and discharging, and to failures.

**Manufacture and Uses of Explosives.** By R. C. Farmer. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921, (Technical primer series.) 116 pp., diagrs., 6 × 4 in., cloth. $0.85.

Information on explosives is so scattered and so much concerned with the details of individual explosives that it is difficult to obtain a general view of the nature and functions of explosives. This book endeavors to provide this, dealing first briefly with the historical development of explosives, and then with the manufacture and use of those most used today. Includes a brief bibliography.

**Materials of Construction.** By Adelbert P. Mills. Second edition, edited by H. W. Hayward. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 9 sections, illus., 9 × 6 in., cloth, $4.

A general textbook covering the manufacture, properties and uses of the common materials of construction, including plaster, lime, cement, clay products, metals, alloys, timber, rope and mechanical fabrics.

**Mineral Land Surveying.** By James Underhill. Third edition, revised N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 237 pp., diagrs., 8 × 5 in., cloth, $3.50.

Describes the methods used at the present time in surveying and patenting mineral lands in the western states. Intended for mineral surveyors and students of mining engineering. Several additions have been made in this edition, especially in the treatment of the direct solar observation. The specimen field notes illustrating the requirements of the office of the United States Surveyor General for Colorado have been rewritten and represent present practice.

**Die Pressluftwerkzeuge.** By P. Iltis. Zweite, umgearbeitete auflage. Berlin, Vereinigung Wissenschaftlicher Verleger, 1921. (Sammlung Goschen.) 117 pp., illus., 6 × 4 in., cloth.

After a brief general and historical introduction, this little book treats of the application of compressed air to hammers, percussion drills, punching, stamping and riveting machinery, drills, hoists and blasting machines. Within its limits, a large amount of information is given on the practical uses of compressed air.

**Principles of Alternating Currents.** By Ralph R. Lawrence. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. (Electrical engineering texts.) 432 pp., 8 × 6 in., cloth, $4.

A textbook developed from notes on alternating currents used for several years at the Massachusetts Institute of Technology with the junior students in electrical engineering.

**Physique Élémentaire et Théories Modernes.** By J. Villey. Pt. 1. Molécules et atomes. Paris, Gauthier-Villars et Cie, 1921. 197 pp. 10 × 6 in., paper, 15 fr.

Less scholastic than usual textbooks and more suited for reading, in which the essential phenomena of physics are set forth and explained by the most modern theories. Attention is especially directed to those phenomena that have received industrial application. Intended for the general public as well as for use as a textbook.

**Protective Relays.**—By Victor H. Todd. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 274 pp., illus., diagrs., 8 × 6 in., cloth, $2.50.

This book attempts to cover the subject from first principles to the protection of high-tension networks, in a manner suited to the needs of operators and testers with a fair knowledge of electricity, and also of designers.

**Rays of Positive Electricity, and Their Application to Chemical Analyses.** By Sir J. J. Thomson. Second edition. Lond. and N. Y., Longmans, Green and Co., 1921. (Monographs on physics.) 234 pp., illus., plates, 9 × 6 in., cloth, $5.25.

This work gives an account of the experiments on positive rays which have been made at the Cavendish Laboratory, together with accounts of researches

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on the Doppler effect in positive rays and on anode rays. Special attention is given in this new edition to those properties of positive rays which seem to throw light on the structure of molecules and atoms and on chemical combination. This edition contains a considerable amount of new matter, both text and plates.

**Steam Boiler Maintenance.** By Reg. Clayton. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. (Pitman's technical primers.) 118 pp., diagrs., 6 × 4 in., cloth, $0.85.

This brief account of good practice is clearly written in language devoid of unnecessary technicalities, to show how breakdowns may be avoided and maintenance costs reduced by systematic supervision. It is not intended to be a guide for firemen so much as to show the weak spots in the apparatus and to lead to the discovery and remedying of incipient defects and malpractices.

**Sewerage and Sewage Disposal.** By Leonard Metcalf and H. P. Eddy. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 598 pp., illus., diagrs., 9 × 6 in., cloth, $5.

Practically a one-volume abridgment of the three-volume treatise "American Sewerage Practice" published by these authors in 1914–15. Intended for class use in engineering schools, but reflects the viewpoint of the engineer, not the teacher, and presents the information that its authors believe young students should acquire before taking up work in the field of sewerage engineering.

**Short Course in the Testing of Electrical Machinery.** By J. H. Morecroft and F. W. Hehre. Fourth edition, revised and enlarged. N. Y., Van Nostrand Co., 1921. 220 pp., diagrs., 9 × 6 in., cloth, $3.

Prepared to meet the needs of students in mining, mechanical and civil engineering, who have not studied the theory of electrical machinery, and hence need a brief summary of it as preparation for laboratory work. Besides specific directions for the tests, a brief analysis of the characteristics of the machines is given. New material on batteries, illumination, measurement of electrical energy and other subjects of interest to engineers generally.

**System Building and Constructive Accounting.**—By Raymond D. Willard. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 307 pp., forms, 9 × 6 in., cloth, $4.

A textbook for students of accounting, devoted to the design of systems for various lines of business. The book analyses a number of systems in use, and illustrates, by charts and forms, suitable methods for the necessary records.

**Theory of the Induction Coil.**—By E. Taylor-Jones. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. 217 pp., illus., 8 × 5 in., cloth, $3.50.

Until recently there has been much divergence of view as to the manner in which the high potential is generated at the secondary terminals of an induction coil when the primary current is interrupted, and it cannot be said even now that opinion on the subject is quite undivided. In this book an account is given of a theory of the action of induction coils first put forward by the author in 1909. The theory was originally intended to apply only to the case of an air-core induction coil having a condenser connected with its secondary terminals. Subsequent investigations have shown that it is also applicable to an ordinary induction coil.

**La Théorie de la Relativité et ses Applications à l'Astronomie.** By Émile Picard. Paris, Gauthier-Villars et Cie, 1922. 27 pp., paper.

The permanent secretary of the Académie des Sciences gives an interesting historical and critical sketch of the theory of relativity with reference to its astronomical applications.

**Valuation of American Timberlands.**—By K. W. Woodward. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1921. 246 pp., maps, 9 × 6 in., cloth, $3.

Gives principal facts regarding timber resources of continental United States and its outlying territories, excepting Hawaii and the Canal Zone, in a form suited to the needs of investors, timber cruisers and students of forestry. Contains descriptions of the forest types of the country, and comparisons of their values.

**Die Wasserversorgung der Städte.**—By O. Smreker. Fünfte auflage. Leipzig, Wilhelm Engelmann, 1914. (Handbuch der Ingenieurwissenschaften. Teil 3. Der Wasserbau, Bd. 3.) 522 pp., illus., diagrs., tables, 10 × 7 in., cloth, 57 Mk.

This work forms the third of the twelve volumes upon hydraulic engineering which constitute the third section of the Handbuch der Ingenieurwissenschaften, and is concerned with municipal water supplies. Thoroughly revised. The arrangement follows the course of operations used in securing a water supply, discussing first the preliminary studies of the amount, quality and occurrence of the available sources, then the design of the plant in general. Succeeding chapters discuss the winning and purification of water, pumping and conveying, and the operation of water-works. Attention is directed toward general principles, rather than to the details of specific installations.

### Geological Reports

The following reports, in mimeographed form, have been received from the Bureau of Topographic and Geological Survey of Pennsylvania; George H. Ashley, State Geologist.

Effect of The War on the Price of Coal in Pennsylvania (Bulletin No 1). By George H. Ashley. 3 pp.
Oil and Gas in Southeast Pennsylvania (Bulletin No. 2). By George H. Ashley. 4 pp.
Development and Probable Life of Gas Pool at McKeesport, Pennsylvania (Bulletin No. 3). By George H. Ashley. 3 pp.
Decline of McKeesport Gas Pool (Bulletin No. 4). By George H. Ashley. 3 pp.
A High-grade Building Stone in Greene County (Bulletin No. 7). By George H. Ashley. 2 pp.
Gas Wells on Pollock Run, Westmoreland County, Pennsylvania (Bulletin No. 12). By J. French Robinson. 2 pp.
Future Sources of Power (Bulletin No 14). By George H. Ashley. 3 pp
Geology of Oil and Gas in Relation to Coal (Bulletin No. 16). By George H. Ashley. 6 pp.
Coal Beds in Cambria County, Pennsylvania (Bulletin No. 23). By J. D. Sisler, 13 pp.
Coal Beds in Greene County, Pennsylvania (Bulletin No 24). By J. D. Sisler. 6 pp.
Coal Reserves in Greene County, Pennsylvania (Bulletin No 25). By John F. Reese. 6 pp.

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## Bureau of Standards Papers

HEREAFTER Technologic Papers of the Bureau of Standards will be grouped in volumes. Beginning with Technologic Paper No. 203, the paging will be consecutive in the series until 750 pages are reached.

A title page and index (issued separately) will be transmitted with the last Technologic Paper of each volume to those libraries or subscribers who receive the complete series.

Subscriptions can be placed for the series of Technologic Papers by sending written orders addressed "Superintendent of Documents, Government Printing Office, Washington, D. C.," and inclosing $1.25 to cover a sufficient number of the papers to make one volume ($2.50 is required if the publications are to be mailed to foreign countries). Separate numbers of the Technologic Papers may be purchased at nominal cost by sending to the same address. (Do not address orders with money to the Bureau of Standards or the Department of Commerce.)

It is no longer possible to complete all the sets from the beginning. The Superintendent of Documents maintains a sales stock which will help to complete back sets, and he reprints any publication for which there is sufficient demand.

Circular 24 contains a descriptive list of all Bureau of Standards publications issued since the establishment of the Bureau. An extended abstract shows clearly the nature of the subject matter and gives in many cases a brief summary of the result. This list will be distributed to applicants free of charge.

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# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau for one month.

Positions of the Bureau are on file in the offices of the member societies of the Federated American Engineering Societies and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Mining Engineer.**—1921 graduate desires position in metal mining. Twenty months in Marine Corps during war. At present employed in coal mining. Single. Age 23. IM–1555.

**Mining Geologist and Mechanical Engineer.**—Desires South American appointment, preferably Argentina, with petroleum concern. Single. Age 25. Speaks Spanish fluently. Available July 1, 1922. IM–1556.

**Foreman Heat Treatment.**—Sixteen years experience on armor plate gun forgings and all kinds of heavy forgings and castings, including erection and operation of many types of furnaces, research testing and experimental work. Age 32. IM–1557.

**Bituminous Coal Mine Executive** desires change. Superintendent, chief engineer, or general superintendent. Western Pennsylvania or north West Virginia preferred. Twenty years experience, seven as chief engineer and assistant general superintendent. Expert on control through cost accounting. IM–1558.

**Mining Engineer.**—Eight years experience in United States, Mexico and Orient in large and small metal mines as prospector, miner, sampler, engineer, shift boss. Age 30. Single. IM–1559.

**Superintendent or Research Metallurgist.**—Capable and experienced millman and research metallurgist desires position in either United States, Canada, or Mexico as superintendent or assistant superintendent of concentrating plant, or as metallurgist in charge of research. Thoroughly familiar with operation and testing of latest types of milling machinery, especially oil flotation, and capable of conducting and directing research along these lines. Speaks Spanish fluently. Single. IM–1560.

**Mining Engineer.**—Sixteen years experience in development, operation, and examination of mines in United States, Alaska, Mexico and Central America. Can get results under pioneer conditions. Prefers Spanish America but will go anywhere. Age 40. Married. IM–1561.

**Mining Engineer.**—Fifteen years practice in milling, cyaniding, flotation and placer mining, in progressive positions from assayer to mill superintendent, in Mexico, Central and South America. Latin America preferred, but will go anywhere. Fluent Spanish. Age 39. Married. IM–1562.

**Mining Engineer.**—Desires position as superintendent or mine engineer. West preferred. Married. Age 30. Competent assayer, accountant, mine surveyor. Ex-1st Lieut. Engineers. IM–1563.

**Mill and Smelter Draftsman.**—Three years with mining, milling and smelting machinery companies, sixteen years with mills and smelters. Age 37. Single. IM–1564.

**Two Technical Men,** one mining engineer and one metallurgist, the former knowing Nevada well, seek a grubstake for a prospecting campaign in Nevada. Both have several years experience and believe can successfully apply knowledge on this trip and acquire by location, option, purchase or lease meritorious mining properties. IM–1565.

**Designing and Construction Engineer.**—Twenty years experience, mining, milling and industrial plants. IM–1566.

**Metallurgical Engineer.**—Successful research and operating experience in iron and steel and non-ferrous alloys. IM–1567.

**Professor of Metallurgy** at large university, with both industrial and teaching experience in non-ferrous metallurgy, ore dressing and fuels, interested in change for next year. IM–1568.

**Mining Engineer.**—Experience: Miner, coal and metals; Lieut. Engineers overseas; oil geology; engineer copper mine; division engineer lead company; resident engineer and assistant superintendent coal company. Prefers connection with reliable consulting engineer in examination and development work. Moderate investment possible. Age 27. IM–1569.

**Mining Engineer.**—Eight years operating, testing, and metallurgical statistics in connection with milling. Crushing, fine grinding, gravity and flotation concentration of copper and lead-iron-zinc ores. Business training course. Southwest preferred. Married. Age 31. IM–1570.

**Metallurgist.**—Specialist in ore concentration desires position as testing engineer or mill superintendent with progressive concern. Experience in testing, hydrometallurgy, concentration, flotation, and in mill design, construction, operation, and management. Business education. IM–1571.

**Mining Engineer.**—Experience in mine engineering, mill operation and construction. Desires position as engineer or assistant superintendent in United States or Canada. Age 30. Married. IM–1572.

**Mining Engineer.**—Varied experience in mining, milling and engineering. Eight years with large corporation as superintendent of underground and surface operation; two years as chief engineer for well known manufacturers of mining machinery. IM–1573.

## Positions Open

**Field Engineer** or scouts to examine for marginal flux or gold-bearing silica. About June 1 to Oct. 1. Apply by letter, giving age, education and experience. Canada. V–384.

**Engineer** familiar with lode mining, milling and operation of small cyanide precipitation plant. An investment of $5000 will be necessary. Colombia, South America. V–393.

**Expert Furnace Designer and Operator** having broad experience in steel works design. Must also have executive experience and ability. V–406.

**Chief Engineer** for large American coal-mining property in British Columbia. Must be coal expert with 10 years experience. Apply by letter only. V–502.

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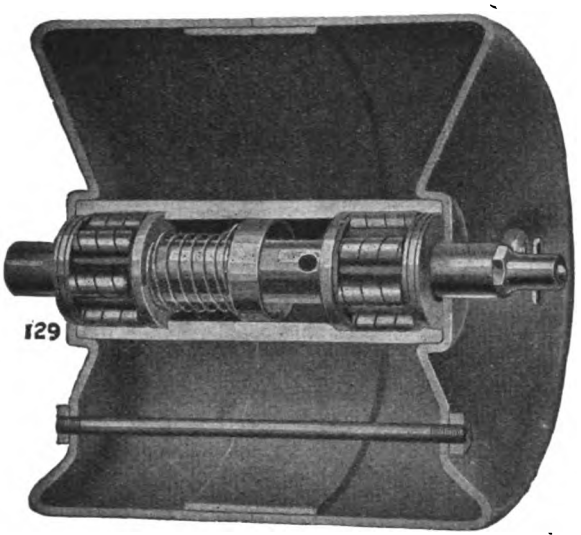
# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

## Pulleys on Belt Conveyors

SPECIAL features of the belt conveyors manufactured by the Stearns Conveyor Co., Cleveland, Ohio, are Hyatt Roller Bearing Idler Pulleys and Lubrication, illustrated in the accompanying cut. Each pulley is fitted with an Alemite lubricating plug, so that the carrier may be lubricated while the belt is running, by means of an Alemite grease gun. The lubricant passes through the hollow shafts into the grease chambers, which hold about six months' supply of grease. On the inclined pulleys,




gravity will furnish lubricant to the lower bearings, but in order to supply the upper bearings, the grease chambers are provided with automatic spring plungers.

Grease from the Alemite gun enters at 1, and comes out at 2, filling the grease reservoir and pressing back the plunger. It is impossible for dust to get into the bearings, as the grease works out through the bearings and forms protecting rings of grease at the only entrance to the bearings.

## Industrial Notes

**The Hardinge Company,** 120 Broadway, New York, announces the acquirement of the coal-washing equipment formerly supplied by the Coal Washing Equipment Co. of Pottsville, Pa. This consists mainly of the James Automatic Balanced Jig, which has been installed in a number of anthracite and bituminous collieries for reducing the sulfur and non-combustible content of coals ranging in sizes from ¼ to 4 in. Another device which has shown surprisingly good results is a combination of pulsating classifier and table capable of lowering the sulfur and ash content of slack sizes of coals, and also the washing of river coals and anthracite culm.* All of this equipment is now being made in the Hardinge Company shops.

Noel Cunningham, formerly connected with the Coal Washing Equipment Co., has been placed in charge of this new department of the Hardinge Company.

**Cement-Gun Construction Co.,** Chicago, Ill., announces that C. L. Dewey, who was associated with Carl Akeley in the invention and development of the cement-gun, and who has done extensive cement-gun contract work under the names of the Dewey Cement-Gun Co. and the Traylor-Dewey Contracting Co. of Allentown, Pa., has joined the forces of the Cement-Gun Construction Co. He will devote his time exclusively to the development of cement-gun contract work.

**Wilson Welder & Metals Co.,** Inc., 132 King St., New York N. Y., announces the appointment of R. L. White as district manager in charge of the Detroit Office, 809 Kresge Bldg., Detroit, Mich.

## Trade Catalogs

**Combustion Engineering Corpn.,** Broad St., New York.—Folder on Type K Automatic Stoker for small plants.

Booklet on Lopulco Pulverized Fuel System for Locomotives. This is said to be the first comprehensive treatise on this adaptation of pulverized coal. Tells of pioneer work and results achieved and contains a number of informative test reports.

**Wellman-Seaver Morgan Co.,** Cleveland, Ohio.—Bulletin 71. Material Handling Equipment as Applied to the Copper Industry. Describes car dumpers, filling bridge, excavating bridge, and excavators.

**Brown Instrument Co.,** Philadelphia, Pa.—Folder on a New Brown High Resistance Pyrometer with two important improvements, *i.e.*, automatic cold junction compensation including means of zero adjustment.

**Cement-Gun Construction Co.,** 537 South Dearborn St., Chicago, Ill.—Gunite Book No. 7. Contains excellent reproductions of photographs illustrating work done within the past two years.

**Scientific Materials Co.,** Pittsburgh, Pa.—Booklet on equipment for examination and photography of the microstructure of metals. Booklet on latest improved American Model Brinell Hardness Testing Machine, with straight line motion depth measuring gage. Leaflet on F. & F. Optical Pyrometer for measuring temperatures from 1500° to 4000° F. (815° to 2200° C.).

**Hercules Powder Co.** Wilmington, Del.—Flotation Oil Booklet, giving complete specfications on all Hercules flotation reagents. The last chapter gives methods for testing oils for adulteration. This booklet, and one by H. J. Stander, which gives a brief survey of flotation, may be obtained without charge by writing to the Hercules Powder Co., Naval Stores Division.

**The Merrill Company,** 121 Second St., San Francisco, Cal.—Booklet of 83 pages, on Merco Processes and Products describing the Merrill Precipitation Process, the Crowe Vacuum-zinc Shavings Process, the Merrill Sluicing Clarifying Filter, the Merco-Nordstrom Plug Valve, and Merrillite.

**Jeffrey Mfg. Co.,** Columbus, Ohio.—Catalog 359. Jeffrey Single Roll Coal Crusher for reducing coal, bone, alum, salt and similar materials.

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# MINING AND METALLURGY

MAY 1922

## COAL-STRIKE NUMBER


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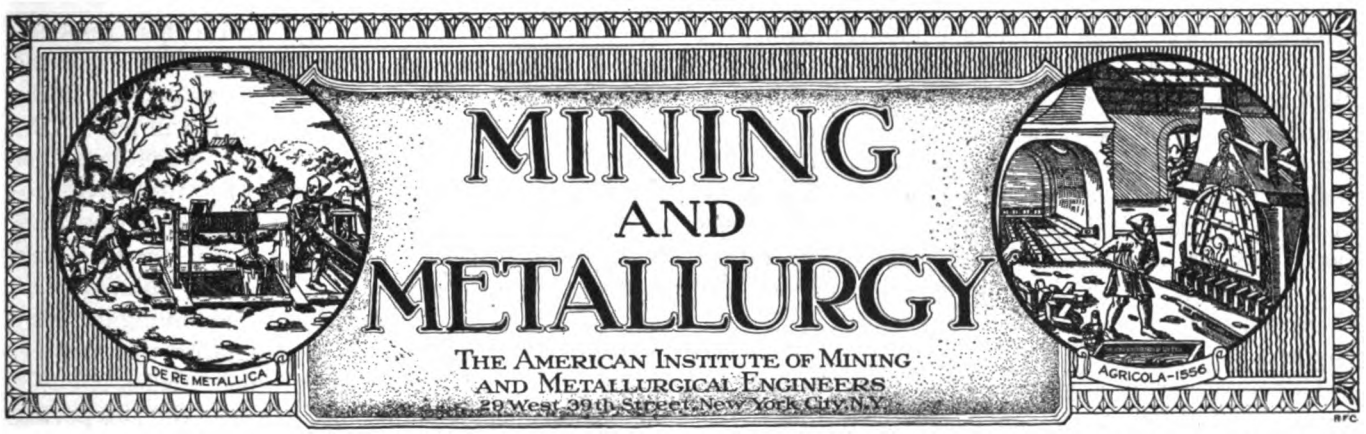


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## EDITORIAL

### The Coal Strike

IN ANY consideration of the present strike of coal miners, discrimination should be made between the positions of the anthracite and bituminous miners. This discrimination will refer to the underlying conditions in the two branches of the industry which I outlined in my address at the joint meeting of the Institute and the Society in February last, *viz.*, the bituminous coal-mining industry is overdeveloped and overmanned, while the anthracite industry is not so. The anthracite miners are now out on strike without any just grievance; while the bituminous miners are the victims of conditions which give them grounds for complaint, although they neither understand what are those conditions nor are they proceeding in the right way to correct them.

The position of the anthracite miners is simple. Constituting a strongly unionized force in the production of an essential commodity, they are endeavoring to retain their war scale of wages at the expense of the public in general, which means at the expense of all other groups of workers. Their retention of an inflated wage scale for so long has been due to the exclusion of competition by a monopolistic labor union and the vicious system of long-time contracts between it and the mine operators. These influences have been powerful in retarding the deflation of the cost of living in general.

In the course of the present controversy, there is being promulgated, as a matter of course, all kinds of statistics that becloud the issue. There is no denial of the fact that the cost of anthracite coal to the consumer is very high; nor can there be any denial of that, for it is self-evident to everybody. The labor leaders claim, however, that this is because the operators pile on their profits and that reductions in price ought to be made out of them. We engineers know that there is no merit in that condition, but there is no use in discussing it for, after all, it is merely a begging of the



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question. The real point at issue is more fundamental, and it is this: Up to 1920, and inclusive of that year, there was annually an increase in the national income until it became about double what it was in 1911–14; but in a general way this was only an increase in inflated dollars and not in quantity of production. The share of labor, expressed through wages, increased in the same way, in the same inflated dollars, but rather more in proportion; for labor's share in the total produce of industry rose from about 70 per cent. to upward of 75 per cent.

These statements are of economic fact as nearly as anything of their nature can be, for they follow the recent report of the National Bureau of Economic Research, in whose directorate the labor organizations are represented and to whose findings the labor representatives assented and concurred.

Since 1920, the business of the United States has experienced drastic deflation. The national income in terms of dollars in 1921 was very much less than in 1920 and probably the present rate is still lower. The anthracite coal miners have retained, however, and are now seeking to maintain, and even to increase, their own inflated scale of wages.

It is not merely the anthracite miners who have done this, but it is also substantially the accomplishment of every group of labor that is strongly unionized. Among the great groups of this class, generally speaking, there are besides the anthracite miners the railway men and the builders. In the broad division of the produce of industry, labor as a whole has already deprived property and management of more than its proper economic share and has done so at its own peril; but that is not a subject to be entered into here. The immediate consideration is this:

With a diminished national income and with nothing more possibly to be abstracted from the share of property and management, of what remains a few groups of labor can maintain their own income upon an inflated basis only at the expense of all other groups of workers, *i.e.*, the public in general. The distress of the farmers and the high degree of unemployment among factory workers are directly due to this.

The anthracite miners are merely a symbol of this broad issue. If they can maintain their position by virtue of their monoply of the labor of an essential industry, the other perfectly unionized groups can do the same thing and all hope for the readjustment to the conditions of normality which must be accomplished before we can look for a return of general prosperity must be abandoned. We should, then, simply have to face a new condition of economic life with grave portents of evil.

The anthracite operators therefore owe a great responsibility to the public in fighting this thing through to the end, and the public owes to itself the obligation of supporting the operators and putting up with such inconvenience as may ensue. I am not sure that either the operators or the public appreciate their responsibilities in the present juncture, and particularly the public which has the most directly at stake. If the public knows what this fight means, it will not let the operators consent to any compromise. I doubt whether the reductions in wages that the operators have proposed be sufficiently sweeping. Anyway, I feel sure that agreement with the unions upon any long-time contract, even for a year, is contrary to public policy. The very fact that the anthracite coal-mining industry is closely controlled both by the operators, who are few, and by the union, which is only one, makes it easily possible to effect a compromise between the two parties upon a wage scale running for a long time, a system which embodies the vicious principle of "cost, plus." The plain necessity is that the public must have cheap anthracite, must have it as cheaply as in 1914, or thereabouts, and must get it on that basis as quickly as possible. I should like to see the operators take the position of "No contract and open shop," and if things lead to the downfall of the union, let that be.

The situation in bituminous coal is different in many elements. The bituminous coal-mining industry is overbuilt, overmanned, is only partially unionized; and it is subject to the competition of foreign coal and also of petroleum. Anthracite mining is an industry that is subject to seasonal fluctuations but on the whole it functions fairly well. Not so with bituminous mining, which is not only subject to seasonal fluctuations, but also functions very badly. This has been the subject of much study, particularly by this Institute, which considered the question at length at its first meeting in 1920. Mr. Hoover, who opened the discussion, pronounced the correction of the evil to be solely an engineering problem, but I am inclined to think that that idea is only partially correct. The evil finds expression in the condition that the personnel attached to this industry habitually finds employment for only a small portion of the working days of the year. In this the workers find a just ground for complaint. Their own naive solution is to establish a 30-hour week, which would tend to equalize the opportunity to work. If, in addition thereto, everybody could draw the pay corresponding with a 48-hour week all would be happy. The trouble with this idea, of course, is that the public would have to pay a large body of men for doing nothing during a large portion of their time, which would be expressed in costly coal.

One of the reasons for the irregularity in the employment of bituminous coal miners is the variation in the demand for coal at different seasons of the year. The unsteadiness of the load factor that is thus put on the mines unbalances the railway car movements and thus troubles are intensified. The engineering solution of these difficulties is to interpolate storage reservoirs between production and consumption, whereby the mines may produce regularly and over-demands or under-demands may be adjusted by means of the reser-

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voirs. Storage facilities necessitate a large capital outlay, however, and there must be adequate inducement for its provision, which the present economic system does not offer.

Underlying all of this, there is the purely economic condition of chronic overdevelopment of the industry. There are too many mines opened and staffed. All of them cannot sell coal to their maximum capacity or even to the needful capacity for efficiency in operation. This is well recognized and various remedies are proposed, such as modification of the Sherman law to permit pooling arrangements, state regulation, governmental control, etc. The best of these would be futile. The worst of them—nationalization—would be ruinous. The simple remedy is to remove restrictions and give play to the natural laws that will lead to the survival of the fittest. One of the restrictions to be removed is the union, with its general wage scales and its destructive influence upon efficiency. The United Mine Workers itself is one of the greatest factors in maintaining the deplorable state of affairs in the bituminous coal-mining industry.

Obviously, the true economic solution of the proper functioning of this industry is the concentration of production in those mines which can produce most efficiently. They should have such freedom in their operations as to permit them to make such reduction in price in times of slack demand as to induce people to provide intermediate storage capacity. Any hampering restrictions, either of labor unions or governmental interference, should be abolished. I do not think that there are any halfway measures between this program and the methods at present existing.

Such a program of economic freedom would lead to the extinguishment of a good deal of capital invested in the superfluous mines, but, as a matter of fact, it has already been economically extinguished although it may not yet have been written off. It would also mean the transfer of the superfluous coal miners to other industries, and there should be governmental assistance in bringing that about. Such work would be a true function of the Department of Labor.

There are at least two other needful things. One of these is the formation among the coal producers of an adequate statistical association, in order that they may keep themselves constantly informed as to how things stand. The other is improved legislation among the states for safeguarding the workmen against accidents. I believe that the United Mine Workers has been instrumental in bringing about the correction of some evils of that nature, and this is the only useful function that that organization has ever performed, so far as I am aware.

With the elimination of the small, inefficient producers, physical dangers also tend to disappear, for the large producer does not want to have accidents and takes measures to avert them. However, as a matter of policy this should not be left in the hands of the operators alone and the function is properly a matter for attention by the state under its police powers. The coal-mining states already have legislation looking toward that end but it should be made more effective and should be on the lines of the recommendations of the committee of consulting engineers of the U. S. Bureau of Mines, as given in *Bulletin* 75 thereof, which would fix responsibilities on the miners as well as on the operators and would make both parties subject to penalties.

I am well aware that these several measures would be resisted by the miners. The latter do not want to be subject to any penalties, not even when they relate to their own well-being as a class, and their union supports them in their spirit of disorderliness. Nor would the surplus of miners kindly consent to being transferred to other industries, for in spite of the popular opinion to the contrary, coal mining is not a particularly hazardous occupation and, in general, is rather pleasant. The coal miners want to be coal miners, but that is no reason why the nation should support more coal miners than it needs.

However, the present strike of the bituminous miners is not going to lead immediately to any such correctives as I have suggested. In its immediate issue the same questions of deflation are involved as pertain to the anthracite industry. The difference in the position of the two industries results simply in the anthracite workers having been able to keep their war scale of wages and get it for work done, while the bituminous miners have kept it, but only nominally; in other words, they have not been able to cash in because there has not been enough work for them. The work has gone to the non-union fields where the miners have been willing to accept less.

While the present contest is not going to result in any early correction of fundamental evils, the operators in this branch of the industry also owe it to the public not to make any concessions. American industries are bound to have cheaper coal. If there be any agreements with the miners they should be by districts only and in conformity with the conditions peculiar to each, and they should not be for any specified times. The check-off should be abolished. If the result should be disruption of the United Mine Workers, that would be both to the public interest and also to the interest of the miners themselves.

W. R. INGALLS.

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## What's Wrong with Coal?

WE DIAGNOSE the industrial symptoms in impressive phrases, as "fluctuations of operation," "deficiencies of transportation," and intermittency of employment," and we express similarly our economic prescriptions for their cure by the phrases "stabilization of industry" and "elimina-

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tion of waste." It all boils down, however, to the assertion that the soft-coal industry is in a diseased condition and the country therefore demands a plain answer to the plain question: "What's wrong with coal?"

The average citizen knows coal only by the price he pays for it and by the size of his ash-pile, and he knows that both are now too high. If he thinks a bit, he realizes that the high price includes a freight rate (surely much higher than before the war) and profits to retailer, jobber, and mine operator (all said to be higher than in former years) as well as the wages of miners (also said to be higher than ever before). All these items are subjects of controversy, but the chief fact back of the high price we pay for coal is that coal really costs more than it did in other days. That's what's wrong with coal; and our next question is "why?"

Irregular operation of our bituminous coal mines is the outstanding reason for excessive costs of mining. The short working year of the miner is bad enough but his short working day adds to the unproductivity, and even worse is the uncertainty of his work. Many other trades have seasonal periods of unemployment, yet the bituminous coal mines of the country, in their very best week, when they were working their hardest to meet a war-time demand, averaged less than 42 hours, and even in their poorest week of 1921 when the country-wide complaint was "No market," they averaged 16 hours of operation. So it is, that with the average bituminous mine open for work only 215 days in the average year and only 170 days last year, the soft-coal miner faces not only the certainty of enforced idleness, but also the uncertainty of telling when his idle days are to come. Absenteeism and loafing on the job are the natural products of such an environment.

It is only too plain, also, that irregular operation requires more mines and more mine workers, and thus involves a sad waste of capital investment and a sadder waste of man power. This excess of capital and of labor in the coal industry, employed but not kept busy, must both seek wages for idle time as well as for working time. The high cost of this inflation of mine capacity and of working force is properly charged against what the mines produce, however short the working year, and the coal consumer pays the score.

The consumer, moreover, can be charged with some responsibility for this excessive cost as well as with the high price itself. The cure for the bad conditions is partly in his hands, for a more regular demand for coal could not fail to result in a more regular operation of the mines. Storage of coal by the consumer must tend to equalize demand and thus to prevent those price flurries, when the market is in the hands of the sellers and the extravagant offers for coal incite the speculative activity of jobbers and operators and thus still further develop a business that is already overdeveloped; and the last state of the industry is worse than the first.

Irregular operation, traceable in large part to blind neglect of the coal producer by the coal consumer, is thus both the cause and the effect of a double inflation that is conservatively estimated at half a billion dollars of misplaced capital and a hundred thousand misplaced men. What other country could support such a spendthrift industry?

But if complete betterment of conditions is to be attained, the coal industry must be its own physician. Legislative panaceas applied externally can do little; the real remedy must be applied underground; the coal-mining industry is in dire need of engineering. Hugh Archbald, in his book just issued, "The Four Hour Day in Coal," a title that is in itself an indictment, has linked together the two words engineering and discontent, and has proved, I believe, that the one is the only cure for the other. The coal operator can find no alibi in the fact that the mine workers have never sought to increase their own efficiency, for, as Mr. Ludlow has said, the bituminous coal business has itself specialized on selling coal, not on mining it; and I am forced to suggest a further parallelism with the labor union, which likewise specializes on bargaining for high prices, for my observation has been that both mine owners and labor leaders employ more lawyers than engineers. Collective bargaining over wage scales or united opposition to public inquiry can not take the place of coöperative effort in raising mine efficiency.

The plain facts presented by Mr. Thacher at the discussion of this subject by this Institute in February, 1920, really constitute a serious charge of inefficient management in the work of the Illinois coal mines as contrasted with the work of the zinc mines in adjacent states, where the average miner handles many times the tonnage credited to the coal miner. That charge remains unanswered; but Mr. Archbald shows that the way to increase the output of the coal miner and thus to swell his real earnings is to organize properly the work both of the industry and of the individual mine, to have engineers distribute the work underground and provide adequate haulage, and thus to give the miner a chance to work continuously a full day and so to maintain a proper standard of living by large earnings rather than by a high wage rate. The world owes the coal miner a living only as he earns it—but he should have a better chance to earn it.

The matter with the nation's coal bill is that it includes too much unemployment and too little productive work, a too-high wage scale and too-low earnings, a shameful waste of human energy instead of a worthy exhibit of thrift in industry, widespread discontent with an uncertain job rather than the wholesome satisfaction a good workman takes in steady and productive employment. The social failure of the coal industry can be traced to economic defects, and the cure for these is engineering. The engineering work needed to make the American coal industry truly worthy of our country will not be spectacular like

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bridge building or canal digging, nor need it await novel inventions or great discoveries in coal-mining methods. What engineering can do for the industry is already known, for we have today large coal mines well laid out and equipped with modern machinery which show in actual practice how we can better the business of mining coal. Our chief need in this business, as in some others, is merely to raise the average up to the best. Mines planned by engineers and managed by engineers can, with the aid of the coal-consuming public, come much nearer to giving the mine worker an actual opportunity to work eight hours a day and six days a week. Then the mine worker himself would have some control of his earnings. Cheaper coal and larger earnings are two ideals which can be attained by engineering after bargaining has utterly failed.

The reform of the coal business must be worked out mostly underground, but its economic and social results will be seen of men, not only in coal that the nation's industry can afford to buy but in mining towns of which the nation need not be ashamed.

GEORGE OTIS SMITH.

## One Aspect of the Bituminous-coal Problem

IN STUDYING the problem of supplying coal to the community, one of the first difficulties that appears is that there are too many coal mines and consequently too many men engaged in producing coal. In round figures, it is estimated that there are 7000 coal mines, employing about 600,000 men. It is probable that 4000 coal mines, employing 450,000 men, could supply all the coal that is required by the United States for its domestic consumption and its export trade, provided the demand for coal could be more evenly distributed throughout the year. It is not necessary, of course, to point out that the public has to pay for maintaining the equivalent of 150,000 men in idleness, who probably each receive an average of $1000 a year; making a total cost of $150,000,000 a year which is unnecessarily added to the price of coal. This amounts to more than 30 cents per ton at the mine, without taking into consideration other additions to costs due to this unsatisfactory state in the industry.

The regulations under the recently passed bill for the leasing of coal lands makes it obligatory on the lessor to develop his lease within a limited time and to produce a minimum of 50 tons per acre per year. During last year, I understand that 15 leases were granted and that 100 were applied for. The average number of acres of land under each lease was 1000. If all of the 100 leases applied for were granted, the minimum amount of coal that would be forced on the market would be 5,000,000 tons a year.

Most of these leases are for land in the Rocky Mountain and the Pacific Coast states. The production of these states in recent years has been about 40,000,000 tons. If the production of 5,000,000 tons a year is added to this with a potential capacity very much greater than the 5,000,000, it will tend to demoralize the coal business of that region still further.

It is one thing to point out a difficulty and quite a different thing to point out a remedy. The fundamental difficulty of the coal business seems apparent. The means for remedying this has occupied the minds of many thinkers for many years. A suggestion has been made which seems to deserve thought and discussion, in order to determine whether it will solve the difficulty or whether the remedy will be worse than the disease.

The first part of the suggestion is that no new leases should be granted on public lands except to an existing company which desires additional land in order to continue its operations or to a new claimant who could show at a hearing before the proper departmental officials that public necessity requires development of new coal land.

The second part of the suggestion is that the Interstate Commerce Commission should have the right to allocate coal cars to a reduced number of operators, sufficient in number so that if the mines were worked full time the public demand for coal would be supplied. If there were full-time work, the earnings of the miners would be adequate, living conditions would be bettered, and coal would be supplied at a minimum cost.

It may be objected that the proposed remedy is too bureaucratic and puts too much power in the hands of the Government departments and commissions. If it is agreed that the fundamental difficulty of the coal industry is that there are too many coal mines, it would appear that there are only two effective ways of limiting the number—by Government regulation or by consolidation. The public opinion of the United States as expressed in its anti-trust laws limits the extent to which consolidation can take place. Therefore, it seems to me desirable that the full extent of the advantages and disadvantages of Government regulation by which the number of coal producers could be limited should be explored to the fullest extent, to see if in this direction a way out cannot be found.

SIDNEY J. JENNINGS.

## Officers of the Institute

ELSEWHERE in this issue (p. 54) is a complete list of the officers of the Institute and chairmen of technical committees and local sections. This is the first list that has been published since the incoming of the new administration in February, and should be preserved for reference. Every member of every committee has been furnished with a complete list of the personnel of that committee and this information will be gladly transmitted to any member who desires it.

PERCY E. BARBOUR.

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# Review of the Month

THE strike of the coal miners began on April 1, as had been expected, the entire force of unionized miners—both anthracite and bituminous—going out and making this the most widespread strike of record. Up to the present writing there has been no serious inconvenience to industry in general, the accumulated stocks of coal being large and the non-union mines having continued to make a substantial production. However, the union labor leaders, having concentrated their efforts toward inducing the non-union miners to go out also, met with some measure of success in certain fields and created a shortage of coking coal, which caused iron makers to bank a few furnaces.

The strike of textile workers in New England spread further. Here and there throughout the country there were sporadic troubles with the builders. Railway labor was the subject of continued palavers, which did not get anywhere. On the whole the events of April were in line with the forecast that this would be a year of labor troubles.

In domestic politics, the soldier bonus bill, having been passed by the House, went to committee consideration in the Senate. Public opposition to it manifestly waxed. On the floor of the Senate the tariff bill was under consideration and is drawing nigh to passage, without there being much consideration of its probable economic consequences. It is going to be a very high tariff and there is much in it that is equivalent to subsidizing small and normally unprofitable industries at the expense of the people as a whole.

Abroad affairs were more quiet, superficially at least, than they were in March. In Egypt, India and South Africa things calmed down, so far as we know, but in Ireland there was continued turmoil. The Irish, having won their freedom to the same degree as the Canadians, have entered upon violent quarrels among themselves, more over phrases than anything else, so far as we can see. Lloyd George obtained a spectacular vote of confidence from Parliament and thus postponed the exigency of a general election.

The great event of the month was, of course, the assembly of the conference at Genoa. This is noteworthy as being the first post-war meeting of all the nations of Europe and without there being any distinction between victors and vanquished. The announcement soon after the middle of the month that Russia and Germany had concluded a treaty between themselves produced a great deal of confusion in the conference, with the prospect that serious results would ensue.

In commerce and industry the situation in Europe remained about as it was, except in Spain where troubles increased. On the other hand, business in Great Britain experienced considerable improvement. Australia continued to meet with difficulties resulting from its labor regime. In the United States there was a certain swelling in activity, which has been talked about for more than it is worth. The explanation is, of course, the replenishing of stocks between the producer and consumer.

In general the increase in business activity, such as it is, reflects the replenishment of stocks of goods, the performance of necessary repair work (largely by the railways), increased building of locomotives and railway cars, a moderate increase in house building, and a considerable advance in automobile building. The last is not a good feature. The fundamentals of the situation remain quite unchanged.

This is not, however, the common opinion, which as expressed through the stock market is foreseeing a rapid recovery from business depression. There has been a wild bull market in which the prices of many industrial stocks have been elevated to relatively high figures, although the time when dividends may be expected from them is far distant. The ease in money, as reflected by low interest rates, does not indicate prosperity, but rather the reverse; but it does indicate the progress of liquidation. It is the absorption of new issues, not merely for refunding, that reflects prosperity, thrift and the use of its savings.

The prophyry copper mines resumed operation on April 1. Now all the copper producers of North America are in motion except United Verde. The copper market after rising to about 13¼ cents in March became quite weak and fell to about 12½ cents early in April, but has since rallied to about 12⅞ cents. Lead became strong, rising from 4.70 cents to 5¼ cents, this being ascribable to continued good demand for white lead, together with an improved demand for certain of the blue lead products, especially building supplies and storage battery material. Spelter also was a little stronger, responding to somewhat better buying by galvanizers and brassmakers, while the possibility of selling for export to Europe, whither some small supplies were actually contracted, was an upholding factor. The markets for pig iron and steel products became a little stronger as a consequence of the coal strike. On the whole, the month of April was encouraging for the metal industries, but with the exception of lead they are still far from a profitable basis.

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# The Coal Crisis of 1922 and its Ultimate Solution

By EUGENE McAULIFFE
President, Union Colliery Co., St. Louis, Mo.

TWO years ago the American Institute of Mining and Metallurgical Engineers made a memorable contribution toward a better understanding of the problems that have for many years confronted the coal industry. Specific suggestions toward betterment were then advanced, certain of which were taken up, amplified and endorsed by men who were conscientiously interested in the work of lifting this great industry out of the morass it has lain in for years. Two certain suggestions then made—provision for seasonal variations in railroad freight rates that would tend to encourage the purchase and movement of coal during the low summer production period, and provision for the collection by the United States Government of all the facts surrounding the industry—were introduced in the form of legislation in the United States Senate by a member of that body, a man whose personal character, antecedents and business training put him above and beyond all suspicion of demagoguery; however, as the result of the insistent, vindictive opposition of the industry itself, these two bills, constructive in their nature, were buried under an avalanche of misrepresentation. Today, with all mines that employ union labor at a stand still, the work of stabilizing the industry is yet before us. As aptly stated by Herbert Hoover, in March, 1920, when he was president of the Institute;

> An engineering organization is particularly the body to undertake this work. It is an economic problem, an engineering problem within the ken of our experience; it is a problem that requires not only constructive thought but quantitative thought and wise social thought.
>
> The engineers of the United States occupy a position midway between capital and labor. They enter upon problems of this kind without prejudice either way, and they have that faculty of mind for quantitative thought, as distinguished from qualitative thought, that takes such problems as this out of the region of politics into the region of matter-of-fact solution.

## The Present Controversy

John L. Lewis is the president of the United Mine Workers of America and, as its chief spokesman, the public will, as a matter of justice, continue to read his presentations of the mine workers' case; likewise, statements of the accredited representatives of the coal operators' associations, that never have been and are not now unified, will be read by the people. Unfortunately, neither side presents all the facts; like the average court witness, each side tells the truth, but not the whole truth, and it is the whole truth that is necessary to the right solution of this vexatious problem.

Mr. Lewis has one talking point that he reiterates at every opportunity, *i.e.*, the failure of the operators in the so-called central competitive field to meet him prior to April 1, as provided for in the contract. What are the facts? At the opening hearing of the Bituminous Coal Commission, Jan. 12, 1920, Mr. Lewis said:

> I am advised, Mr. Chairman, that the United Mine Workers are here to assist the Bituminous Coal Commission in every proper and practical way to arrive at their conclusions, and to coöperate in every manner, and to submit our interests to the commission, without reservation, and shall abide by the judgment of the commission.

The majority and minority reports of the commission were handed to President Wilson on March 10, 1920, article *C* of Award (p. 53) reading: "That the agreement for which this award constitutes a basis shall take effect April 1, 1920; and continue in effect up to and including March 31, 1922."

This provision was later written into the four-state agreement and signed by the several state representatives of the United Mine Workers from Pennsylvania, Ohio, Indiana and Illinois. With the promulgation of the four-state agreement, it was "resolved that an Interstate Joint Conference be held prior to April 1, 1922," etc. On the failure to carry out the terms of this resolution, Mr. Lewis is attempting to build his case before the tribunal of public opinion; it is the hub around which his whole structure revolves. In presenting the existing situation to the 10,000 members of the Institute, any approach toward a partisan attitude must be excluded and all reference to Mr. Lewis must be looked upon as wholly impersonal; he is merely the guiding hand of the machine. The coal operators of Western Pennsylvania and Ohio made a strategic mistake in not meeting Mr. Lewis prior to April 1, 1922, but has Mr. Lewis forgotten that in July, 1920, the mine workers in Illinois and in portions of Indiana, Pennsylvania and Ohio (this same so-called Central Competitive field) struck, demanding a revision of the wage scale (of which the resolution providing for a joint meeting prior to April 1, 1922, was a part) and eventually returned to work under a new agreement which gave day men an increase of $1.50 per day effective Aug. 16, 1920? Has Mr. Lewis likewise forgotten that President Harding called him to Washington for

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a conference which was held on Oct. 8, 1921, the purpose of the President, as well as of the Secretaries of Commerce and Labor, Mr. Hoover and Mr. Davis, that of arranging a meeting between the operators and the mine workers to the end that no interruption of production on April 1 should occur? This is the meeting which should have been held, the date sufficiently advanced to have made possible the avoidance of the then unnecessary, enforced and unseasonal storage of from forty to fifty million tons of coal. Mr. Lewis forgets that while the operators agreed to the call for the meeting, he and his associates refused to commit their organization to any prior understanding pending the anticipated National Convention which was held in February, where the 30-hour week and other things were demanded for the bituminous workers and an increase of $1 per day for shift men and 20 per cent. for contract men was demanded in the anthracite industry; likewise he is silent on the point that although the anthracite operators did actually meet the union in New York City, March 15 last, their mines went out on a strike April 1, with those of the bituminous operators who did not meet them. Mr. Lewis's attempt to use the failure of the Penn-Ohio operators to meet with him (after he had flouted the request of the President and his cabinet) under the terms of an agreement that he and his constituency did not hesitate to breach in November, 1919, and in July, 1920, is a mere smoke screen to hide the real situation. One substantial reason for the refusal of the eastern operators to meet [Mr. Lewis after his national convention had promulgated their unreasonable and impossible demands has not been given to the public, that is the certain knowledge that the officers of the mine-workers' union dare not hand their followers the revised wage scale that must come unless it carries with it that necessary concomitant, work. Both the operators and John L. Lewis know that the country is saturated with coal. Consumers began to buy in December, 1921. They bought and stored during the mild winter season, paying for much of the coal stored less than mine cost; they bought quietly, even insidiously, miners and operators alike believing that the reduced output of the mines was being used currently. For once, the consumer did not suffer panic and, as a matter of fact, the solution of what the lawyers call "the instant case" rests neither with Mr. Lewis nor with the operators.

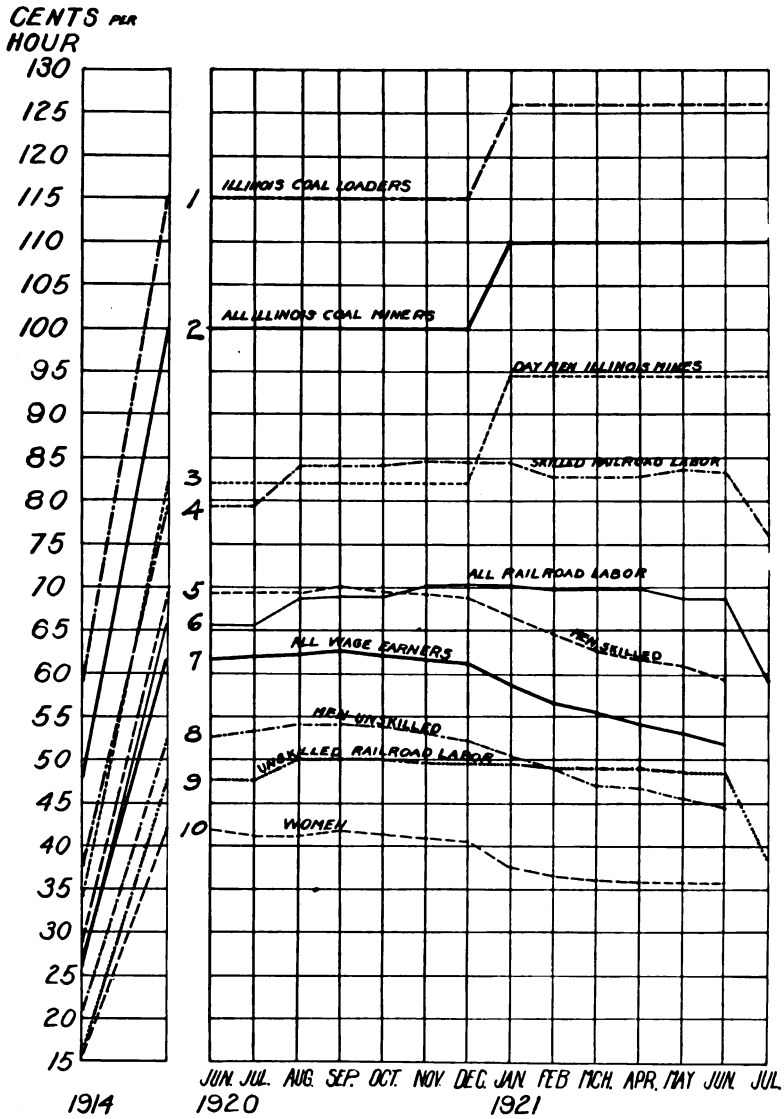


FIG. 1.—AVERAGE HOURLY EARNINGS VARIOUS LARGE INDUSTRIAL GROUPS, JULY, 1914 TO JULY, 1921.

Lines 1, 2 and 3 from official statistics Illinois Coal Operators Association; lines 4, 6 and 9 covering railroad labor, and lines 5, 7, 8 and 10 covering industrial plants, taken from Research Reports Nos. 45 and 46 of National Industrial Conference Board.

### THE REAL ISSUE

Mr. Lewis continuously dodges the real issue at stake; it has been and is still being dodged by other selfish and shortsighted men. This issue is one of the deflation of war and post-war prices. He is not the only character whose record is that of trying to hold out to the end. Perhaps he has in mind the story of that courageous but ill advised Frenchman, the last of Napoleon's Guard who, when in the closing hours of the battle of Waterloo was called upon by an English captain to surrender, gave as his answer one untranslatable word. Mr. Lewis stands today at the end of a blind entry; in front of him is the solid wall of economic facts, the only road to daylight is the one the farmers took two years ago, which the coal operators and the manufacturing industry took in the fall of 1920, and which the railroad employees whose aid he sought a few weeks ago have been treading for many weary months, with the end of their journey yet afar off. It is madness for the leaders of the four or five

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hundred thousand mine workers, who under proper leadership will always ring true, to try to teach the pernicious belief that the coal industry is one in which

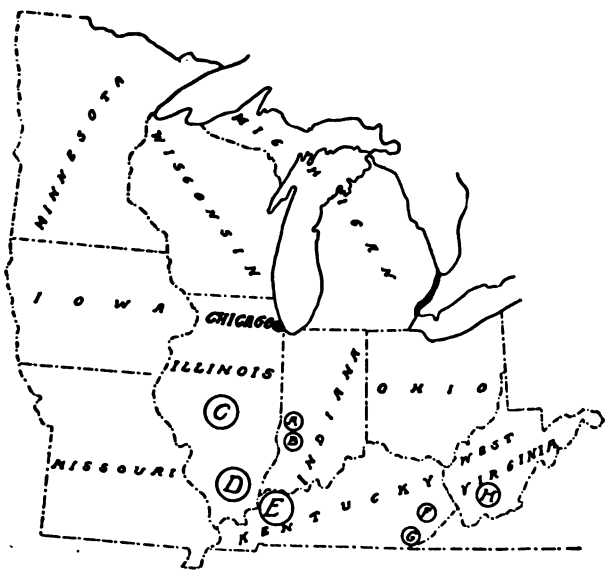


FIG. 2.—MAP SHOWING RELATIVE LOCATION OF EIGHT PRINCIPAL COAL FIELDS SHIPPING TO CHICAGO, THE WORLD'S GREATEST COAL MARKET.

| SYMBOL | COAL FIELD | MILES FROM CHICAGO | EXCESS PER CENT. IN MILES REQUIRED TO REACH CHICAGO |
|---|---|---|---|
| A | Clinton–Brazil | 159 | |
| B | Sullivan–Linton | 228 | 43 |
| C | Springfield | 236 | 48 |
| D | Southern Illinois | 305 | 92 |
| E | Western Kentucky | 400 | 151 |
| F | Hazard, Kentucky | 543 | 241 |
| G | Harlan, Kentucky | 584 | 267 |
| H | Pocahontas, W. Va. | 646 | 306 |

the devotees can continue to occupy a pedestal apart from that of the mass of their fellow citizens.

## THE CONDITIONS SOUGHT

The mine workers in unionized territory seek not only to retain a war wage extorted from the consumers of coal in defiance of the findings of a governmental commission appointed to fix the wage, but they seek to increase it, and, through the medium of a shorter working period, continue to impose on the consumers of coal approximately 150,000 men who are not required by the industry. To do this they seek a unit wage so high as to make possible, by working three or four days per week, the gaining of sufficient to carry the excess number of men mentioned. The comparison of wages paid in the coal mines of Illinois, which are representative, and those paid in other lines of endeavor well expresses the rarified altitude into which the mine workers have lifted themselves (Fig. 1.). When it is recalled that the young man who operates a haulage locomotive in an Illinois mine receives $9.04 for a day's work while the locomotive engineer who drives the mammoth passenger locomotive of today, responding to every call, in any hour, any weather, receives $6; while the railroads cut off and dismissed during the 12-months period ending September, 1921, a total of 446,-550 employees, a force equal to the entire army of soft-coal workers; it is time to "stop, look and listen."

## NON-UNION COMPETITION

Much has been said in praise of the non-union miners located south of the Ohio and Potomac Rivers. During the strike of Nov. 1, 1919, when the mine workers challenged not alone the whole American people but their accredited governmental heads, the non-union mines kept the nation in fuel, at a great loss, however, attendant on the long rail haul required and the dislocation of the empty coal-car supply which resulted in car shortages and high prices throughout the greater part of 1920. Today these same mines are in many cases paying a wage rate below what the union mine worker terms a proper standard of living. This situation is fundamentally wrong and to the extent that the miners' union has created the condition, it is deserving of criticism.

As the situation stands today, the coal-mining investment of the nation is "half slave and half free." To create a similar division between the mine workers north and south of the line above mentioned is unsound. There is an American standard of living, and the opportunity to enjoy it is the rightful heritage of every good citizen and law-abiding alien among us. For months,

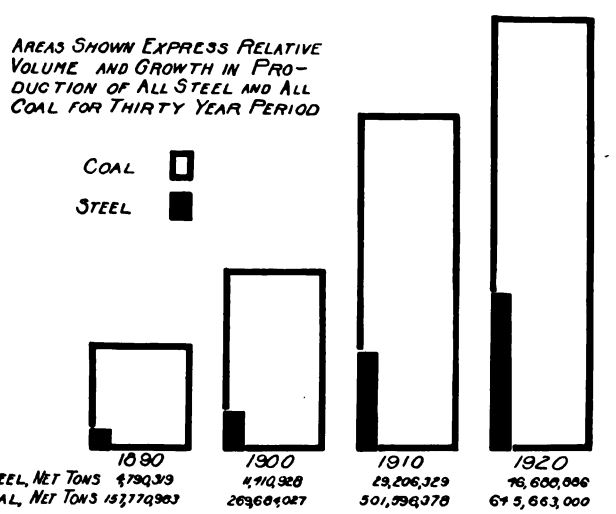
AREAS SHOWN EXPRESS RELATIVE VOLUME AND GROWTH IN PRODUCTION OF ALL STEEL AND ALL COAL FOR THIRTY YEAR PERIOD
COAL
STEEL
1890
1900
1910
1920
STEEL, NET TONS 4,790,319 4,410,928 29,206,329 46,600,666
COAL, NET TONS 193,770,963 269,684,027 501,596,378 615,663,000

FIG. 3.—STEEL THE BAROMETER OF TRADE, AND ITS WEIGHT IN NET TONS COMPARED WITH COAL, WITH THE GROWTH OF THE TWO PRODUCTS FOR 30 YEARS.

under the stress of a wholly artificial economic situation, many mines north of the rivers mentioned were closed down, others worked from 5 to 50 per cent. of full time, while the non-union mines south of the rivers undersold them in their natural markets, the nation taking up the difference in mine cost in the form of an increased transportation bill occasioned by the excess expenditure of the gross-ton miles required to transport the tonnage so diverted an undue distance. From the standpoint of all the people the end result lies in:

1. The closing down of properties and enforced idleness of the labor attached to same, north of the dividing line.

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2. The stimulus toward the development of additional unnecessary mines with the extension of and additions to equipment of old mines, south of the dividing line.

3. The waste of labor, fuel, train and engine supplies, etc. employed in moving coal, a heavy commodity, an undue distance by the railroads and the dislocation of railroad equipment.

4. The arbitrary diverting of opportunity for labor from union to non-union fields with the enforced migration of union workers to non-union fields.

All of which tends to postpone the stabilization of this great industry.

cannot exist by the free and voluntary support of its own membership has no justifiable place in our social structure. The enforced membership and payment of dues such as exists here is slavery, no more, no less. The condition should be wiped out with the end of the present agreement.

### Collective Bargaining

I have expressed before this my belief in the theory of collective bargaining. I am in favor of unions soundly constructed and honestly administered. All unions should be forced to incorporate and should be

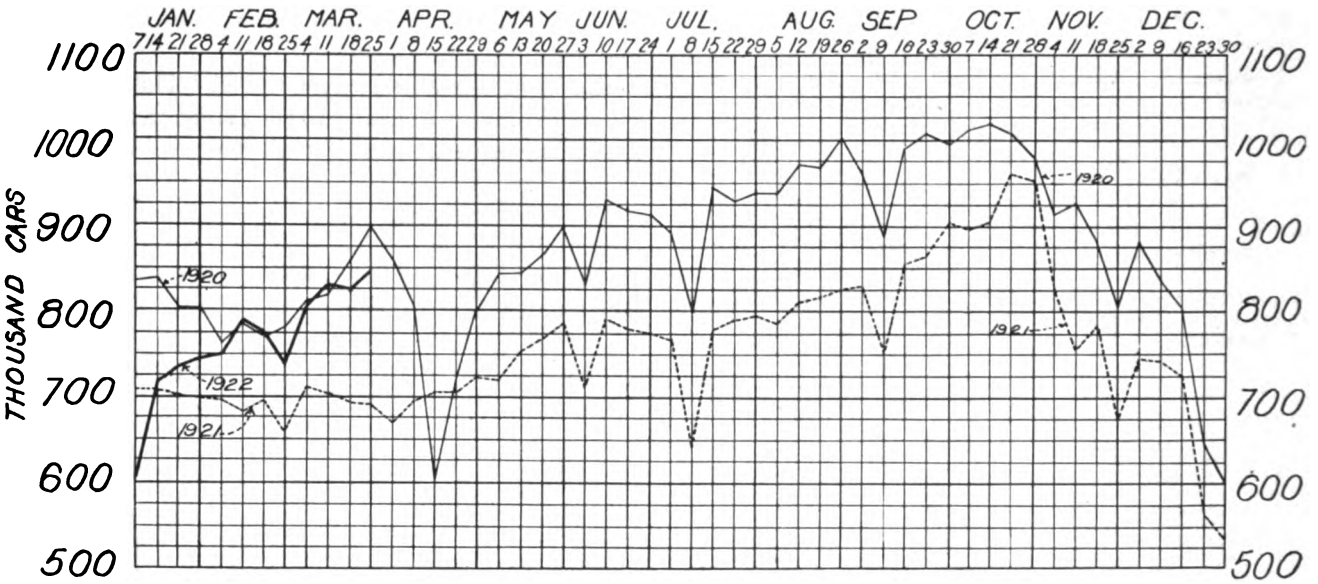


Fig. 4.—Revenue car loading years 1920, 1921 and first quarter 1922 compared. Compiled by American Railway Association.

The map (Fig. 2) with tables of distance from the natural sources of supply, as well as those thus artificially created, to the world's greatest coal market—Chicago—offers a clear visualization of the waste of transportation the taxpayers are paying through the railroad payroll.

### The Check-off

At the foundation of the abuses that surround the mine-workers' union lies the much discussed check-off. Years ago certain operators agreed to collect at the source certain special assessments levied for sick benefit and funeral purposes. From this modest beginning the abuse has grown until the tax levied on mine workers, and through them on the consumers of coal, runs into millions of dollars annually. This tax, running frequently above six cents per ton of coal produced, is used to build up and maintain the machine that in the fall of 1919 defied all three branches of our National Government, executive, judicial and legislative. The mine-workers' union is the only union in existence that requires the employer to collect its dues and assessments at the source. A union that

subject to all of the laws, rules and regulations that govern corporate or partnership holdings of capital goods or accumulated savings, including the payment of federal income and excess-profits taxes. All malicious interference with the operation of a mining property by its labor should be eliminated. A cross-section of the average mine committee will usually disclose the fact that the principal qualifications for membership are a lack of family ties, absence of home ownership or other property holdings, a plethora of unpaid bills and a blatant vociferous talking capacity. Rarely do you find a home owner, of whom there are many among the mine workers, on the "pit committee;" neither does a home owner care to hazard himself to the insult to which he is usually subjected when fair treatment and considerate action is advised.

### Mine Worker and Absenteeism

The industry is a vital and fundamental one, its workers should receive good, fair wages, but the problem of caring for the fluctuations in volume of business between years of activity and depression is one that cannot be cured by excessively high wage rates.

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The wages paid mine workers today in the union fields runs from 100 to 250 per cent. above those paid in the non-union fields. One extreme represents an excessive wage that is strangling all industry, while the other suggests a wage too low to maintain even the most conscientious worker; neither condition one that will best serve the nation's welfare. I have a definite feeling that unduly depressed wages are even less defensible that those inordinately inflated. Whenever wages are considered, the offense of voluntary absenteeism from work exceeding 10 per cent., which is common to the mine worker, must not be forgotten.

Mine workers as a class absolutely refuse to recognize their responsibility to the industry. Absenteeism represents a condition that has grown up gradually; it is an uncontrolled privilege suffered by no other industry. The first duty imposed on the mine staff after starting time in the morning is that of seeking substitutes for men occupying what might be called "key" positions, motormen, tripriders, machinemen, etc. who are essential to the creation and movement of the tonnage which the loaders place in the pit cars. This situation tends to reduce the day's output, it increases the unit cost and multiplies the hazards attached to mining.

Under the contract, the mine worker cannot be approached on the question of absenteeism providing he reports on alternate days on which the mine works; that is to say, if he is absent Monday, he may return Tuesday, absenting himself on Wednesday and so on, this without even the formality of an excuse. The more flagrant cases, who stay out for several days in succession, will advance excuses based on trivial family affairs behind which the mine management cannot go. During periods of active work, 25 per cent. of absenteeism in some mines is not uncommon.

Whatever the measure of such action, get clearly in your mind that to obtain a given average output the entire plant investment, including underground development, mine machinery, track material, rolling stock, etc. must be increased and maintained in working condition in amount equivalent to the measure of absenteeism suffered. To this must be added the loss sustained from the indifferent services rendered in certain important positions, by loaders who resent being drafted for emergency service as motormen, machinemen, etc. What office, factory, or mill organization would tolerate the continued absence of 10 to 25 per cent. of its employees, without even the formality of notice? Further, and unlike any other form of unskilled labor, the loaders, who approximate 60 per cent. of the mine force, begin leaving the mine at the end of the fifth hour, continuing to straggle out thereafter. It is not probable that the working day of this class of labor runs on an average to exceed six and one half hours.

The annual turnover due to the migratory and shifting habits of mine workers represents an economic loss in excess of that suffered by any other form of industry. There are some splendid men in our mines; that is evidenced by the fact that approximately 35 per cent. of the men on the payroll earn 60 to 75 per cent. of the wages paid during each two-weeks period. This better element, however, is dominated and overrun by the irresponsible minority who vociferously exploit the "rights of labor."

### Discipline Within the Industry

A sound relation does not now and never will be created between the industry and its employees until the leaders of the union are compelled to cease all petty interference with the management of the mines. In no other industry does puerile interference and complaint reach the proportions that obtain in a coal mine. The men *per se* are not responsible. The trouble rests with the machine itself which has been built up on a foundation of money extorted from the workers in amounts so huge as to submerge leaders gifted with much greater poise than exists here. Given a mine wage approaching that paid other labor of equal skill and importance, and the competition between employers for labor insure the mine worker his just deserts, particularly when seconded by an enlightened public opinion.

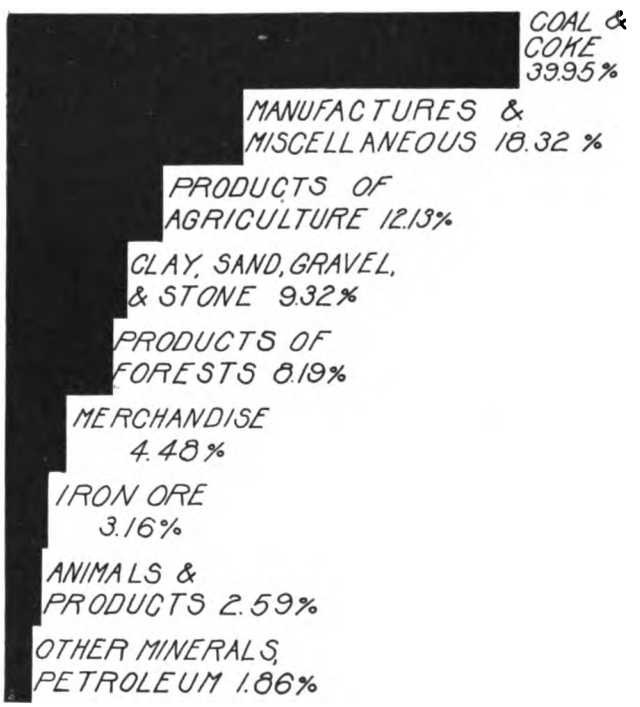
COAL & COKE 39.95%
MANUFACTURES & MISCELLANEOUS 18.32 %
PRODUCTS OF AGRICULTURE 12.13%
CLAY, SAND, GRAVEL, & STONE 9.32%
PRODUCTS OF FORESTS 8.19%
MERCHANDISE 4.48%
IRON ORE 3.16%
ANIMALS & PRODUCTS 2.59%
OTHER MINERALS, PETROLEUM 1.86%

Fig. 5.—Comparative tonnage of revenue freight tonnage originating on class one railroads for calendar year 1921, from records of Interstate Commerce Commission.

### Magnitude of the Coal Industry

The nation holds three great outstanding lines of industrial endeavor: the railroads, the coal mines and the steel industry. Steel is frequently referred to as the barometer of trade. The steel and iron industry consumes approximately 100,000,000 tons of coal

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annually. The steel-making fuel movement in the form of coal and coke, as well as that of the finished product, makes heavy demand on the transportation resources of the railroads, so heavy it can be well said that the three are interdependent and related industries. The comparison and growth in net tons set forth in Fig. 3 shows clearly how far coal and steel have traveled together in the past three decades.

### Settlement of the Instant Case

In a preceding paragraph the statement is made that the settlement of the existing controversy rests without either the operators or their employees. Mr. Lewis and his official editor have repeatedly laid stress on what might be called "the process of attrition" as the force that will ultimately break the deadlock which now exists; this was the method employed on Nov. 1, 1919. It failed then and it will fail now. To repeat, the country is saturated with fuel, and with nearly every union mine entirely stripped for the first time in years coal is a drug on the market and the 600,000 tons held in cars on mine tracks is quite unsalable. The large amount of coal in storage is not held by the operators for higher prices, as stated by Mr. Lewis and Editor Searles, but was bought at or below cost and is now far beyond the speculative seller. Mr. Lewis sought, some weeks past, an alliance with the unions representing the 1,600,000 men engaged in railroad service, the express purpose given being that of furthering the common interest of both classes of labor. Mr. Lewis and the writer are both advocates of the theory of collective bargaining, but differ in the determination of the territory that should be covered by the bargain. The writer advocates bargaining with the men serving the industry within the state or district wherein the mine is located. Mr. Lewis has more Napoleonic ideas of empire, he proposes that an Illinois operator bargain with all the miners on the North American continent, under rules originally "dictated but not signed" in Europe, the trade so made to carry the approval of all the railroad employees in the United States. Like that other historical character who once started a fight, he is given to taking in too much territory. The existing strike will be settled ultimately because of its effect on the transportation necessities of the country. In 1921, the railroad tonnage was 75 per cent. of that of 1920. For 18 months the transportation machine, with a subnormal supply of cars and locomotives, and an abnormal accumulation of deferred maintenance of equipment, road bed and buildings has rendered all the service the country asked for. The past few weeks point conclusively to a turn in the tide. Until the coal strike occurred, unemployment was decreasing; the steel mills, furnaces and factories have quickened into life, building is being resumed and the railroads have already purchased 70,000 cars against 28,358 ordered in 1921. May and June will pass without coal panic; with July will come the start of the great Western States grain movement; the Northwest will then begin to think of its dock coal movement and of the winter that settles down early in the northern tier of states; New England will want coal from all its usual sources of supply and when this time comes the ghost of a transportation shortage will beckon with an accusing finger. Railroad executives and the Interstate Commerce Commission have the transportation-demand curve for many years before them; it begins to climb in July. The curves showing revenue freight-car loadings for 1920–1921 and the first 11 weeks of 1922, Fig. 4, suggest the motivation that will determine the close of the coal strike. Few of us fully sense the insolubility of the relation that exists between the coal industry and the railroads. Above and beyond any other commodity, coal and its product, coke, make demands on the carriers. The chart, Fig. 5, shows the relation that these items bear to all other freight originating on our railroads. It will be observed that our manufacturers and merchandise which includes steel total less than 45 per cent. and all the products of agriculture total but 30 per cent. of the weight of the nation's coal and coke. It is Coal that is king, regardless of his past and present maladversions.

### How Permanently to Cure the Coal Cancer

The coal industry has been shown with lucidity as occupying a position vital to our whole industrial and economic structure; withal it is cancerous and the disease must be cured. The industry is not the private property of the owner and the mine workers, its foundation rests on a natural resource necessary to the whole people. The invested capital, directed by managerial skill, the mine labor, skilled and unskilled, the transportation companies, and most of all the public are dependent on the successful conduct of the industry. Operators and more recently union heads agree that the industry is overdeveloped. The mine workers, however, demand a unit wage sufficient to keep every man who can gain a foothold in the industry, whether or not the public requires his service and without regard to the wages due to capital. They further propose to reduce the potential weekly work period 37.5 per cent. by cutting the working time from 48 to 30 hours; they offer no plan, however, that will prevent the further development of mines that would undoubtedly follow. In substance, they ask that the equivalent of a second mortgage be put on the industry and the public who support it, for the temporary benefit of that six-tenths of one per cent. of the nation that pays dues into the mine-workers' organization. The consumers of coal are becoming tired of having their coal bins taken over and made the scene of recurring labor brawls, and as coal labor affairs are now conducted there is no assurance that any settlement that may be made of the existing deadlock will prove permanent; the country

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may find itself in the midst of another coal strike on Nov. 1 next. Wholesome constructive coöperation on the part of those concerned will solve the problem. We do not wish to see the blighting hand of government ownership closed over the industry, stifling individuality and initiative, and wage commissions deluged with fragmentary and partisan statistics do not offer a good foundation for industrial peace. As stated by Mr. Hoover, quantitative thought and the exclusion of politics will furnish the solution. To the members of the Institute and the coal-consuming public, the following specific suggestions are offered:

1. The enforced incorporation of all labor organizations with provision that such be subject to all of the laws, rules and regulations that govern corporate or partnership holdings of capital, including the payment of federal income and excess-profits taxes.

2. The reformation of the United Mine Workers Organization, including the elimination of the check-off, with such revision of policy as will insure a better recognition of the relation the industry bears to our national economic life and a decent regard for public opinion; the organization to transform its present policy of resistance to greater individual productivity into one of productivity, including the giving of proper encouragement to the installation of labor-saving machinery.

3. Full recognition on the part of the employer that the mine worker is entitled to that fair living wage consistent with the American standard of living, regardless of whether he mines coal north or south of the Ohio and Potomac Rivers; the employee recognizing with equal force that to earn he must produce.

4. The enactment of legislation that will insure a full finding of facts concerning the industry.

5. From the facts so secured, the Secretary of Commerce should publish promptly, monthly and annually, the essentials that concern the public, including mine labor.

6. From the evidence so secured he should keep the Interstate Commerce Commission informed as to the ability of the then existing mine development to serve the full needs of the nation with that required for export and bunkerage.

7. The transportation act should be so amended as to require every railroad desirous of rendering transportation service to a coal mine to secure from the Interstate Commerce Commission a certificate of convenience and necessity before entering or serving same.

8. With a deflation of mining cost and a resumption of industrial activity, the industry would in three years overtake its present over expansion and gradually and without violence sufficient men would be withdrawn to give those remaining from 275 to 308 working days per year, more particularily if a campaign of education and encouragement of the public was directed toward an effort to eliminate seasonal demand.

## The Coal Consumer and His Strike

By J. D. A. Morrow*

THE above title seems to indicate a discussion of the present coal strike. The National Coal Association does not deal with labor matters or wage controversies. I shall adhere to that limitation and shall not discuss the policies or issues in the present strike. It serves here merely as an illustration.

The present coal strike is not John L. Lewis' strike nor the operators' strike, but is the coal consumers' strike. He is the man responsible for it; and this statement is made neither in praise nor blame. For a year the coal consumer has been making it painfully plain that he will have lower-cost coal. He has been readjusting the basic economics of his business and of his household. Among the items he early marked with red ink for reduction was the cost of his coal. Operators of certain non-union coal mines who can readily understand a fact as emphatically put as the coal consumer put the above-mentioned determination decided many months ago that it was good business to pay some heed and act accordingly. They did so. The coal consumer increased his business with them. Their employees, though on a lower wage scale, had more work to do and increased their weekly and monthly earnings.

The coal consumer withdrew more and more of his business from union mines where the production cost under the wage scale, and hence the selling price was above that of the adjacent non-union mines after they had readjusted their wages. The union operator could not lower his wage scale and the coal consumer gave him less and less business. His men had less work and smaller earnings than miners in adjoining non-union operations. The New England coal consumer is typical. He normally takes about half his bituminous coal from union and half from non-union mines. For months prior to April 1, however, he was taking twice as much from non-union mines as from union fields.

The coal consumer has the undoubted right to buy his coal where he can buy it most economically. The placing of his order determined whether union miners or non-union miners would dig his coal and receive a wage therefor. His choice closed many mines long before April 1, 1922, albeit the operator tore his hair in an effort to operate and the miners proclaimed their willingness to mine—at the union wage scale. The consumer had struck these mines. Walter McKinney, out at Columbus, tells me that the coal consumer struck 169 mines in southern Ohio for the whole year of 1921. Union operators are convinced that the consumer will continue his strike indefinitely unless they readjust their production cost, and therefore their wage scales, more or less in conformity with his ideas. More, they sympathize with the consumer and think him right. The United Mine Workers do not sympathize with him and think him wrong.

*Vice-president, National Coal Association, Washington, D. C.

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Some politicians and some newspaper writers proclaim the present controversy as a strike of the miner against the operator. Dead wrong; it is a strike of the miner against the consumer, or vice versa, as you please. Some politicians may think it good politics to back the United Mine Workers because they have more votes than the operators. Dead wrong again; the coal consumer has far more votes than either the miners or the operators, or both combined, and it behooves all and sundry who love political preferment to remember that after all this is the coal consumer's strike. It may be that he is even proud of his strike and might bite the leg off anybody who tried to take it away from him.

Now for the moral. When we talk of stabilizing the bituminous coal industry, perhaps it would clarify our thinking if we would scratch out the words "coal industry," write in "coal consumer" and read it over again thus, "stabilize the coal consumer." We would then get a more accurate measure of the real problems involved in this much talked of stabilization. It is a very popular idea just now in Washington and elsewhere. Civic leaders, statesmen and lesser lights are devoting themselves to "stabilizing the bituminous coal industry" so that the mines will run more steadily, there will be less overdevelopment, less unemployment, less intermittency of work. There are not a few who think this a task for government. Before any such verdict is signed, sealed and handed in it might be well to consider the coal consumer, who has no reverence for the miners' union and may have no more for "stabilizers."

As matters stand now, said coal consumer can buy his coal anywhere he wishes at any time. He can even go and open his own mine and his own coal land. When we strip the current stabilization talk of its umbrageous decorations, most of it comes right down to a denial of these present rights of the consumer. If overdevelopment is to be checked, the opening of new mines must be controlled, and the unrestricted right of the coal consumer to open up his own coal for his own consumption must be denied. That will mark a fundamental change in all our ideas of private property since before the days of Alfred the Great. If irregularity and intermittency of operation are to be cured, the coal consumer's freedom to obtain his coal when and as he wants it must also be restricted.

Even so, this may all be well worth while and to the consumer's interest. Nevertheless, whoever urges such a program may well stop and ask himself the question "How will the consumer take to this proposal?" The United Mine Workers suggest stabilizing employment by a six-hour day and five-day week. The coal consumer will settle that proposal once and for all before he finishes his strike. He may be equally decisive in his action toward some of these stabilization proposals.

This is not written in opposition to conservation or stabilization, nor in depreciation of the need of a sounder business basis for the bituminous coal industry, of a surer return for capital and of better employment conditions for labor. Everyone connected with the industry understands the need for betterment in these respects and must hold himself in readiness to go far to bring them about. The coal consumer and his present strike serve to remind us, however, that in this practical world we must keep the gentleman in mind when we talk of conserving our coal measures and of stabilizing our coal industry. The big job is to make these things work with the coal consumer.

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## Coal and Public Utilities

By W. S. Barstow*

THERE is no business in which the public is so vitally interested as that having to do with the mining and distribution of coal. While it is true that the operation of this industry at first thought appeals more to the individual in private life, yet it is soon realized that it is the very foundation of industrial existence. That the mining and distribution of coal has been permitted to function along lines of great economical waste, without exciting more than an occasional interest, is, therefore, the more surprising. An industry demanding the highest ability in management, as well as honest efforts on the part of labor, has gradually departed from all principles of commercial efficiency and is at this time seriously impeding the recovery of general business.

The industry having to do with the generation and distribution of electrical energy has been designated as a "public utility," and yet coal mining, which is the foundation of that industry, has not yet been included in this class. For many years the operations of public-utility companies have been regulated by state commissions, which were created as a protection both to the investor, in his investment, and the public, in its service. The largest one item in the expense of a public-utility company is coal; and on this expense must be based the charge to the public, as well as the return to the investor. When we realize that the mining and distribution of coal is conducted along wasteful lines, and is in the hands of those who seem to be free of all obligations to the public in stabilizing this industry, we can see how vitally every individual should be interested, through public utilities, in the coal situation.

In an endeavor to control to a degree the one large item of expense, many a public-utility company purchased a coal property, and then, more than ever, it was brought face to face with the coal-mining situation as it actually existed, and realized that in effect its functioning was worse than that of all other industries. If a public-utility company is to continue to give efficient service, at reasonable cost, the coal industry must develop along efficient lines.

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# Some Issues in the Coal Wage Controversy

By J. G. PUTERBAUGH
President, The McAlester Fuel Company, McAlester, Okla.

MARCH 31, 1922, undoubtedly will be long remembered as the ending of an important epoch in the coal-mining industry. On that date, contracts fixing the wages and terms of employment at all anthracite mines and at approximately 60 per cent. of the bituminous mines of the country expired.

For the past two years, the consuming public has been complaining bitterly against continued high cost of coal. Coal operators employing union labor have felt obligated to carry out contracts entered into under the direction of the Bituminous Wage Commission appointed by President Wilson, and in order to do this, they have sacrificed millions of tons of business to non-union mines, and millions of dollars in wages that would have been distributed throughout unionized districts have been diverted to the non-union miners, many of whom never obtained the peak wages granted by the Bituminous Commission and others of whom accepted reductions early in 1921.

Heretofore, wage contracts have overlapped as to expiration dates in different districts and renewals have had to take into consideration the competitive balance; the present situation is unique in that practically every contract in the country expired on March 31, and the questions now confronting those responsible for the operation of the coal mines of the country are:

1. Shall the operators that have heretofore employed union labor endeavor to continue contractual relations with United Mine Workers of America?
2. Shall they undertake to operate their mines with non-union labor?
3. Shall they encourage and endeavor to work out some plan of regulation or arbitration by a Government commission such as President Roosevelt appointed to settle the anthracite strike in 1902?
4. Shall the country give consideration to the demand of the miners that the coal-mining industry be "nationalized?"

Operators that have endeavored to operate their properties with union labor are emphatic and practically unanimous in stating that they cannot and will not continue to be responsible for the management of their properties without a larger measure of authority and control than they have been able to exercise over union labor during the past several years.

Prior to 1900, the coal miner regarded himself as the slave of the operator. Gradually, since 1910, he has become the slave of the bosses of his union. He has very little to say as to the terms and conditions of his employment, as to when he will work or strike or as to the percentage of his total earnings that the union officials shall "check off" and require the operator to deduct from the wages of the "rank and file."

The employer is the natural leader and should be the "Big Boss" of those he employs. He should command their respect and their loyalty, and his prosperity should mean their prosperity. In the battle of business, one operator and his employees should be pitted against a competitive operator and his employees. Operators and men of one district should compete with operators and men of another district in their efforts to serve the public best, and profit in proportion to the success of their joint efforts.

The union idea completely abolishes the idea of loyalty and coöperation between employer and employee. Our illiterate miners, fully two-thirds of whom are foreigners and a great majority of whom are unable to read the English language, are constantly taught that their employer is their natural enemy, that he has no interest in their welfare and that he is seeking to get from them the most in service for the minimum return.

## Opposition Crystallized in Minds of Employees

Where substantial concessions have been made to labor, officials of the union have, for their political aggrandizement, taken full credit for having "forced" the advances; and in these and in many other ways, the minds of ignorant laborers and the minds of their wives and children have been crystallized into a state of prejudice, antagonism and envy against their employers, who are supposed to be piling up enormous wealth which does not belong to them. It is obvious that such a relationship does not work for efficiency and that the industry and the public must pay heavily for the continuance of such an unhealthy situation. As a result of increasing suspicion of employer by unionized employees, the employers of union labor have despaired of educating their men to a knowledge of the real facts and, in fact, have abandoned the field entirely to the officials of the union, the organizer and the socialistic press.

The soil, therefore, is in no condition to accomplish a friendly, coöperative understanding. It is far

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from the mind of labor to realize or concede that a comparatively trifling percentage of the dollar the operator obtains for his product remains in his hands as profit. Neither do the laborers realize that, in a great majority of cases, the portion that does remain as profit is re-invested for the improvement and betterment of the mines which afford the opportunity to make a living.

Many who concede the right of labor to organize do not realize the tyranny of the enforcement of the closed shop. Thousands of miners in union districts, many of whom own their own homes, would be glad to be relieved of the tyrannical domination of union bosses and officials and of the deduction of a large portion of their wages as union dues. They are good, law-abiding citizens, and have no sympathy with or tolerance of the numerous petty strikes that are called for the personal aggrandizement of union politicians, but in union districts, the non-union employee who seeks employment at mines must be notified by the operator that his application cannot be considered until he has taken the oath of allegiance to the union, paid his initiation fee and obligated himself to obey its mandates.

### Union Torn by Internal Dissension

The union today is torn and seething with internal political strife, and the interests of the rank and file and the interests of employers are in every way subordinated and made secondary to the interests of the powerful leaders of the organization; and, as a result, operators, miners and the public alike are paying the penalty. The upward trend of wages since 1900, the credit for all of which has been claimed by the "organization," has enabled the union to prosper, both numerically and financially, but even the rank and file today realize that the organization has overplayed its hand and that this is going to make the problem of readjustment and liquidation doubly difficult.

The history of labor organizations is that their machinery does not lend itself to successful retreats and that the leader who accepts defeat is repudiated by his former followers, and those who have sown the wind to obtain preferment generally reap the whirlwind. The real controversies within the ranks of the union have little to do with the welfare of the rank and file, and no concern for the welfare of the industry and the public.

Obviously, such a condition is deplorable, and its continuance intolerable and entirely un-American, and it is clearly against the best interests of the American public that it should be tolerated or continued; those responsible for the coal-mining industry of the country will be derelict in the performance of their public duty if they do not insist on a radical and complete reformation.

Some operators in each district believe that a uniform and standard schedule of wages is desirable, and they have been encouraged by this idea to try to continue collective bargaining and the closed shop, but the great majority of union operators, if asked why they tolerate the continuance of such an unhealthy situation and why they do not go open shop, will frankly state that they hesitate to do so in the fear that their properties will be dynamited. Suits against the union for the value of properties destroyed in this manner have been brought and are now pending for final decision before the Supreme Court of the United States, and the public will doubtless soon know whether or not the United Mine Workers of America as an organization can be held financially responsible for the acts of its members.

Undoubtedly, many of the miners now classed as union men would welcome the opportunity to work under non-union conditions, if assured of protection and of not being again forced to go back into the union as "scabs."

As 40 per cent. of bituminous coal of the country is being produced by non-union labor, that has accepted readjustment of war wages, and as coal produced by this non-union labor has made heavy inroads, since the beginning of 1921, on the trade territory of union mines, and as there is ample producing capacity in these non-union districts to supply the country's needs for many months to come, even though the union operator is willing to bear the indignities of the system heretofore in effect, he cannot pay anything like the wages demanded by the union and compete with non-union mines. The wage schedules and market prices fixed by non-union mines, therefore, mark the key to the coming wage adjustment. Union operators not only will be destroying the value of their own properties and putting themselves out of business, but will be throwing out of employment union miners if they compromise or settle on a wage that will deliver the business to the non-union districts which are already the strongest and most powerful in the country.

### Labor Subject to Supply and Demand

This hard fact brings us to the realization that, after all is said to the contrary, labor is a commodity and is subject to the law of supply and demand. Mr. Gompers and other leaders of labor refuse to admit this truth, and are contending for the maintenance of certain human standards and certain "minimum" wages, without relation to the value of the service or what the public is willing to pay for it. A union carpenter or brick-mason will not buy union-mined coal if he can buy wood, fuel oil or natural gas more cheaply. Hundreds of members of the farmer's union throughout the West, during the past winter, have positively refused to pay the price of coal, and have burned the surplus corn. Union railroad men in Memphis, Tenn., or Chicago, Ill., will buy non-union coal from West Virginia or Alabama if that coal is obtainable at a lower price than union coal from Ohio or Illinois. The

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operator and the property he owns is only the agency through which the miner sells his labor to the public in the form of coal. Therefore, is it not clear that, if the finished product must compete with the product of non-union districts, the real competitors are the miners of the two districts; and is it not apparent that, if union men themselves will not pay more for union products, the miners of union districts must meet the competition of non-union labor or abandon the industry?

Clearly, where the situation is so nearly balanced as in this country, the gage of the wage the union bituminous operator can pay is that accepted by non-union labor. Therefore, it would seem clear that either union labor must eliminate itself as a factor in the industry or become reconciled to the meeting of competition, just as employers must do in the marketing of their product. The officials of the United Mine Workers of America state that they do not propose to accept wages being paid to non-union labor as a standard. They steadfastly refuse to recognize the inexorable operation of the law of supply and demand, which has operated from the beginning of time and was not enacted by coal operators or by any human government, and therefore must be sound. We must concede that union leaders, during the past several years, have, by virtue of their control of mine labor, accomplished many seemingly impossible and illogical things, but whatever mistakes may be made by operators or Government in the settlement of this great question, it is obvious that the great law of supply and demand will not exempt labor from compliance with its operations, and clearly, much confusion and much destitution and strife and resultant human misery could be avoided if workmen could be told and made to understand the truth.

### Question of a Living Wage

One of the strongest and most plausible contentions of labor in the present controversy is that, even at the existing wages, the annual earnings of union miners during 1921 were sufficiently great in only a few districts to equal more than a fair living wage. In order to clearly consider this contention, we must not forget that the business depression which became most acute during 1921 was world-wide and that it was not to be expected that during such unprecedented periods as the world was passing through, and while thousands abroad were starving for lack of a few grains of corn, the people of this favored country would entirely escape their share of the punishments of war.

The miners' union, the railroad brotherhoods and many other organized groups are seeking to use the tragedy of a world war as a stepping-stone to a position of permanent ease and luxury which they have not earned by honest toil and service to humanity. They are using the power of their organization to wrest from a weakened world unfair advantages. By contending for a high paper wage, instead of conceding equitable readjustments that would materialize into greater, rather than less, annual earnings, they not only are blindly punishing themselves, but every consumer of fuel, and they are also spragging the wheels of returning prosperity.

The ignorant coal miner is struggling in the balance between what seems to be a logical and sensible course of procedure and the alluring theories, hopes and promises of an illogical and, in many instances, an insincere leadership.

Coal operators, railroad managements and the public should coöperate to equalize demand for coal throughout the different seasons of the year. There is no question that in districts where seasonal fluctuations are great they should be overcome by graduated mine prices and graduated freight rates. It might be further desirable to make seasonal fluctuations in wages. Except in war times, consumers can be encouraged to buy coal far in advance of requirements only when there is a mometary inducement for so doing. Transportation is such an important factor in the marketing of coal that the Interstate Commerce Commission should coöperate in the solution of this problem.

### Public a Controlling Factor

It is clear that there can be no return to normal industrial activity and coal consumption until the public is satisfied that the cost and selling price of coal, transportation, labor and building materials has declined to a firm and reasonable basis; and there is a feeling that these items are more likely to advance than to go lower. The country is standing still waiting for the coal industry and the transportation industry to get back to earth and to take pot-luck with the farmer and the many other groups that have had the courage and the foresight to take their "medicine," unpleasant though it was, and which, by virtue of their action, are now rapidly convalescing.

Apparently, it is the hope and belief of the miners that within a few short weeks the Government will again intervene and take upon itself the responsibility of a settlement, but in view of the magnitude, complexity and infinite detail involved in mine wage contracts, it is scarcely to be hoped that the kind of Government commissions that have functioned in connection with this problem during the past several years could or would bring about a settlement that would be equitable or in the interest of the public. No Government commission can annul or mitigate the keen and growing competition of non-union coal produced by non-union miners who are already accepting much lower wages than many of the union groups are offering to pay.

It is imperative that the coal miner reform his viewpoint and that, in return for the wages he receives, he undertake to render a full day of honest service; in other words, that he work for and not against the employer who gives him work and finances his payroll. The miner is sadly and viciously misled as to the

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attitude of the employer toward the employee and his incorrigible attitude and consequent lack of coöperation is easily increasing by 20 per cent. the cost of union-mined coal as waste and without anything like a countervailing benefit to labor. The union miner is, or should be, more interested in the correct economic solution of this controversy than is any other interest, as, should he gain what his leaders are contending for, it would mean his own complete undoing.

In the interest of the public, their employees and themselves, the coal operators of the country, who know the facts and the real issues involved, should at any cost to themselves individually hold out for not only a proper and just readjustment of wages but for such control of their properties and employees as will enable them to operate efficiently.

## The Coal Miners' Demands and the Way to a Solution

By William Hutton Blauvelt*

THE present coal strike for the first time includes both the anthracite and bituminous fields, although the two industries have little in common except that their dissimilar products are fuels necessary to our national life.

In the bituminous fields, the present strike is the outcome of the demand by the United Mine Workers for higher wages. Claims that the operators in the central competitive field have broken faith by refusing to meet the union is a mere technicality. The demand for higher wages has aroused little public sympathy because the present wage rates are already far in excess of those now paid in other occupations calling for a similar degree of skill. The operator demands that lower rates of wages be established in order that coal may be delivered at lower prices to the consumers. Neither side of the controversy has touched the real problem, which lies far deeper. It is, undoubtedly, the fact that the cost of coal to the consumer and the cost of mining coal are too high. It is also true in very many cases that the miner is not receiving sufficient wages to assure him a reasonable living; but any agreement which may be reached as to wage rates will be only a temporary adjustment and the problem of the coal industry will still demand an economic solution.

The demand of the mine worker for a six-hour day and a five-day week meets no public response, especially in the minds of those who are working a nine or ten-hour day, five and one-half or six days a week. If the miner could be reasonably assured that in times of average prosperity he could have the same number of hours work per day and days per year as in other industries employing a similar class of labor, public opinion would soon settle his rate of wages in line with other industries. The problem of the bituminous coal industry in America is its stabilization in line with other industries producing commodities required for the public good; and since the coal industry is so basic to all industry, the need for its stabilization is correspondingly great. The solution of this vital problem must be economic, not political. Natural laws must be recognized, not disregarded. A situation must be established, which, acting in harmony with natural law, will produce the desired results.

At present the capacity of the bituminous mines of this country is about 40 per cent. above the requirements of an active demand, and more than 150,000 miners are employed in excess of efficient requirements. Many mines are and can be operated only during times of high prices, and during these times they take the cream of the business, leaving to the regular operators the long-term contracts at lower prices.

The naturally seasonal conditions of the coal industry add to the difficulties of the problem, but the Lake Superior iron-mining operators have stabilized their naturally seasonal work in large measure and possibly their experience may suggest something to the coal operator.

Unfortunately, the public is interested in the problems of the coal-mining industry only when prices are high. Before the war, it was said that in the state of Illinois the majority of the coal operators would be found to be insolvent if they were compelled to balance their books. At that time the price of coal was very low and probably only the best equipped mines were operated at a profit. The consumer was entirely satisfied to obtain his coal at prices that in many cases were below cost and there was no public demand for a solution of the conditions in the industry, although such a time would have been far better than the present for the working out of a plan for stabilizing the industry.

Any solution of the problems of the coal industry must be fair to all, including both regular operators, who have invested large sums in the development and equipment of their mining properties, and those who operate only during periods of high prices; but it is clear that the "snowbirds" and wagon-mine operators add seriously to the difficulties of the problem. The public is convinced that national ownership of the mines is not the solution, but that some form of organization for coöperative effort, with proper governmental supervision, would cure many of the present evils, if the right plan can be found. When public interest requires it, coöperative effort can be legalized for the coal industry, as it has for the farmers and for the export trade.

Railroad transportation and car supply are so intimately connected with the coal-mining industry that it is possible that we may find there an important aid in stabilizing the production of coal. Possibly a plan could be worked out that would give some form

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of preferred car supply to the regular operators, based on their previous requirements over a period of months. Although this might work hardship on some, the greatest good to the greatest number must finally rule, and the public interest demands a permanent solution of the situation and an elimination of the highly uneconomic conditions now ruling throughout the industry.

The public has confidence in Mr. Hoover and the Department of Commerce of which he is head. I believe that a study of the situation, initiated by Mr. Hoover, on the lines indicated above, and carried out by men who will forget partisan politics and seek only the true economic solution, would bring an answer acceptable to the public and satisfactory to the great majority of operators and miners. No national problem is more vital to our industrial success today, or more in the minds of the public and those engaged in the industry, whether as operators or miners.

## Clouding the Coal Labor Situation

By Carl Scholz*

EVEN to the casual observer, it is obvious that the present coal strike is the result of several years' propaganda on the part of the miners' leaders, who have used every effort to monopolize the industry, and it is remarkable to what extent they have been encouraged by a part of the press and a number of politicians.

Although nationalization of the mines has long been one of the hopes of the leaders, not until now have they been bold enough to announce this policy publicly. This demand is so absurd that even such politicians as have favored the miners' side in the past have taken no interest, and perhaps have not given this demand any more serious consideration than the request for a six-hour day and five-day week, which the editor of the *Mine Workers Journal*, in a recent article to the *Saturday Evening Post*, says was not made seriously. That is just about the way in which the demand for the check-off was made 20 years ago; nothing serious, just a little help in collecting the dues, is the manner in which it was put to the operators of Ohio, who first collected the check-off. When the proposition was presented to the operators of Illinois, it was expressed in a more positive manner, then it became and has remained the chief bone of contention during the last 20 years in the other 15 coal-producing states where it has been in effect since that time. When we stop to consider that a part of the $20,000,000 collected annually has been used to fight some of the state governments and to cause an enormous expense to the Federal Government, we look upon it as a really serious situation, and one that may well engage the attention of the Federal judges who are being advised of the menace which this check-off is to the country. For illustration, the Logan march cost the Federal Government $1,000,000 in 1921 by bringing troops to West Virginia. No mention has been made of the cost of the various commissions and committees and legislative investigations which have been instigated by the miners' leaders, without any foundation whatever except self aggrandizement of the officials and a possible increase of the check-off as a means of revenue and fighting fund.

Just as the check-off became a settled fact as a result of constant effort, so it has been the hope that nationalization and reduced hours will come about.

During the war the miners' president, pleading for an increase in the miners' wages, on account of the higher cost of living, said that unless these increases were made the miners would desert the fields and engage in other occupations. At the same time, every effort was maintained throughout the war period to reduce production per man employed by prohibiting any man from doing more than one class of work, even if it required only a fraction of a day to do it, and such inconsistencies have been conducted by the miners' leaders to this very day. In the organized fields, the percentage of day laborers compared with loaders and machinists has been constantly increasing, and the cost of production has increased on this account, even more than by direct changes in wage rates.

It is not wholly impossible that the underlying reason has been the desire to increase the income of the national organization from the check-off, because in the bituminous field every additional man employed means something like $20 per year to the national organization. In the anthracite field, where the check-off has heretofore been limited to $1 per month, the main fight is made for the unlimited check-off. The coal consumer pays not only the cost of the check-off in his coal bill but also the damage caused by it, which is perhaps ten times greater. It is generally conceded that the check-off in the bituminous field is about 5 cents per ton, and the cost of production by restriction of day labor is estimated to range from 20 to 60 cents per ton. These figures are authentic and can easily be verified.

Now the miners' leaders ask for a reduction in the hours worked per week at the top war-wage rates, in order to furnish employment to a greater number, claiming that the present wage is necessary to maintain the large number of men working in and around the mines.

What would the farmer reply if his hands should say that they wanted to work only five short days per week, so that all could be employed, but they would have to get their board and full pay? If this theory is correct and work in the mines is made so attractive, by the time the next contract period comes around it would be quite feasible for the miners to ask for a three-hour day and four days per week, and ultimately they would have to be maintained without doing any

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work at all, merely for the pleasure of visiting the mines. This is wholly contrary to the principals of competition and the inexorable law of supply and demand.

Those who do not deal with the miners and their representatives do not understand the methods resorted to, and may be interested in a few illustrations. When the illegal strike in the fall of 1919 was in effect, Mr. Lewis promised President Wilson to call off the strike and did so, but Mr. Wilson had failed to exact a promise that the men would return to work, and the miners remained idle. Now, in any other industry, when a strike is called off it means return to work, but not so with the miners. General Banholtz had the same experience when he investigated the Logan march: the miners' leaders, who had ordered the men to march to Logan, promised the General that they would recall them, but the men did not return, for reasons that were well known to the coal operators, and General Banholtz was compelled to go back and take several thousand soldiers before the miners returned to their homes. In the bituminous commission award, the miners agreed not to obstruct the introduction of labor-saving devices, but this agreement has been violated a number of times.

The officials of the companies who sit on the grievance boards can furnish hundreds of examples where the miners' officials used their wits to retard production and increase the cost, and it may be said that they are usually well informed and by no means backward in threatening strikes to gain their points. In this country, where the greatest opportunity exists for cheap fuel, and lower fuel costs mean reduced freight rates, we should have increased production by increasing the demand from industries; there should be prosperity in every hamlet instead of cries of poverty and subscriptions for the starving; but with wages increased three fold within the last 10 years and a reduction of 50 per cent. in the output per employee, we find ourselves confronted with conditions that engage the attention of Congress, when if such a move were made by any other class of labor it would be dismissed without a moment's consideration.

If left to the coal producers, the question of production will soon take care of itself. If the business is over-capitalized, the excess capital will be lost, and the loser will have no more claim for his losses than the miner should have for the wages which he does not earn.

In several foreign countries the syndicate plan has worked successfully, because it has eliminated a tremendous economic loss by keeping only enough men at work to produce the required tonnage and has afforded steady work for the men engaged in the industry, and has utilized the capital to the best advantage by keeping the mines constantly at work. It has also carried with it an obligation to work and has reduced strikes to a minimum, all of which results in reduced cost of production. Under the existing laws of the United States, such a syndicate plan is not feasible, but the results abroad have appealed favorably to investigators from this country, including the engineers of the Bureau of Mines and some members of the Federal Trades Commission, particularly Edward Hurley.

Through prolific, but unscrupulous, press agencies, the miner's story has been put before the public in a manner to cloud the main issues, because the regulation of production could not in any way be connected with the labor problem, as these are separate and distinct matters.

The greatest impetus which the miners' leaders received dates back to the signing of the Adamson bill, at which time the Gomperized White House dealt with a feeble hand with a situation that required practical knowledge rather than idealistic dreams.

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## Fallacies of the Coal-strike Situation

By J. B. Warriner*

THE faults of the mine workers are due to lack of understanding of economic and industrial conditions, and of the natural laws that govern such conditions. The blame for this situation, if blame exists, and the remedy as well, are sociological problems, with which we are not here concerned.

It is a more serious fact, however, that the tendency of the mine workers, as of most other working men, is to follow the leadership of those whose comprehension of economic problems is of the same order as their own, rather than more conservative and thoughtful men; for this reason, their leaders as a rule do not pass down to followers, who watch with always a suspicious and sometimes a jealous eye, the facts they learn from better informed men during negotiations of wage scales and agreements. These conditions, unfortunately, are inherent in labor organizations. They will be with us, to some extent at least, as long as unions of employees exist; and such organizations are still a useful part of the social body, and will be in existence, though perhaps in modified form, for many years to come.

The only proper quarrel that we can have with employee organizations is over the fact that they have become too powerful and too involved in organization politics to function fairly and without menace to the public. The mine workers' organization, for instance, covers so many and such divergent fields that local matters in any one field, easy of settlement by themselves, are made the sport of quarrels between leaders and would be leaders, with too little reference to the intrinsic merits of the problems themselves. In time, these things may adjust themselves, but until they do so, the organization is not one to command confidence. This is the time for plain speaking, and

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much as I am in sympathy with the principle of employee organizations, I cannot view their present trend without apprehension.

An equally serious difficulty in the present situation is lack of comprehension by the public of questions involved. This is not an unnatural condition. Coal mining is a complicated industry with innumerable phases and ramifications. Our newspapers publish confused and complicated facts and rumors from all the mining fields, giving equal weight to irresponsible propaganda and to the carefully considered and provable statements of spokesmen for the employers. The public, naturally, is unable to discriminate between facts and propaganda, or to apply known facts to the proper mining fields. Thus, even clearly marked and fundamental differences between the anthracite and bituminous situations are not always differentiated in the public mind. This is not strange, but it is regrettable. The American people are too apt to pass judgment on matters of which they are not fully informed, and the efforts of thinking men everywhere should be given to combatting this tendency.

At this time, it is true, the public seems to have a clearer appreciation of the issues involved than ever before, but its judgment is still swayed by certain widespread fallacies. The public believes, for instance, that the profits of coal mining are unreasonable; though numerous investigations have proved the fact that no great industry in the United States is operated on so small a margin of profit; many also believe that the operators of the coal mines are their natural enemies, though the fact is that the operators stand, and have always stood between the public and the exactions of labor unions, and have held the price of coal to reasonable figures at the risk of all the losses attendant upon industrial strife with their employees. The public at these times usually has given its support to the side of the labor unions, and therefore has reaped what it has sown, or has deserved that fate.

Another widespread fallacy is the belief that industrial strife between employers and employees in the coal industry has resulted in suffering to the public through shortage of coal and high prices. There is always the threat of a coal shortage when wage agreements expire and must be renewed by negotiation, but the fact is that the public has not actually suffered from a shortage of anthracite coal for at least 20 years, and, so far as I know, has never suffered from a shortage of bituminous coal. I cannot argue in detail the justness of anthracite coal prices, and can only reiterate what has been said so frequently by spokesmen for the anthracite operators, that the present prices of anthracite coal at the mines are due almost entirely to high labor cost, and that these prices will undoubtedly be deflated at this time in line with the general deflation, which the public has willed since the war in the price of practically all other commodities. Personally, I should be glad to see anthracite mine workers' wages remain where they are, if this were an economic possibility. The mine workers, however, are a part of the general public, which, aided by economic conditions, has forced prices down in all other lines, and they cannot avoid the workings of the same law, or consistently desire to do so.

My connection is with anthracite operations and, though I have kept informed of conditions in the bituminous fields, it is impossible for one not directly connected with those fields to grasp fully all the ramifications of the questions involved. Nor do I want to fall into the same fault for which I blame the American public, of passing judgment on complicated matters of which I do not have full and detailed information.

I agree with Mr. Hoover that the bituminous industry is overdeveloped, and that, from an economic point of view, it functions badly. I cannot agree, however, that so far this has been to the detriment of the public. The great overdevelopment of the bituminous fields has been an insurance against any shortage of this essential commodity at any time or place. It has also induced intense competition, with resultant low prices. Before the war three tons of bituminous coal could be mined by complicated processes underground, brought to the surface, loaded into railroad cars and sold at about the price of a medium-quality pair of shoes. In many cases these prices were less than the cost of production, and present prices are only moderately increased over the old. In the long run, however, it is not to the benefit of the country that such conditions should exist. Posterity eventually suffers when resources are wasted and industries are starved. I do not believe, however, that there is any remedy for the situation that can be applied from outside the industry itself. The bituminous operators, granted exemption from amateur interference, should be able shortly to solve their own problems.

## The Coal Problem in Wyoming

By P. J. Quealy*

THE instability and present condition of the coal business, I charge most positively to radicalism in union labor as the chief factor. I admit and believe that both skilled and common labor, while employed within the mines, are entitled to some better pay than like classes of labor employed outside.

In the great majority of work required in the production of coal in the mines, there is very little skill required that could not be acquired in a few days. The conditions of labor in the coal mines, as compared to other labor on the outside, are not unfavorable; and I speak from personal experience, having worked as a miner for nine years after I entered the mines as a boy until I became a foreman at 21 years of age. In fact, once a

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man is initiated in the mines, it is preferred to similar labor outside.

Therefore, the demand for shorter hours than eight, or double time, etc., is unreasonable. The present demand for wages, as required by the international union, in the mines, which is equal to more than double what similar labor is paid for outside of the mines in other industries, being $6.94 for common labor outside the mines and $7.50 and up inside the mines, is unreasonable. These rates should not be allowed, as they practically double the labor cost of coal production as compared to labor cost in other industries. The contract labor per ton is also relatively high.

The demands made by the unions at the last international convention at Indianapolis, for shorter hours and five days a week, etc., on account of the seasonal character of the occupation, are just as unreasonable as if applied to any other industries affected by seasonal demand, of which there are many; as the same class of labor is busy at other available occupations during the summer season when the surplus is not required at the mines. The principal reason why coal miners refuse to leave the mines and seek other employment when some mines are working only two or three days a week is that they earn so much more when they do work, per day, than the same class of labor is paid for at other available occupations.

Just as long as the present relatively higher rates are paid in and around the coal mines, union labor will insist that the rate of pay must not only be maintained but that it should be increased in order that the men may remain idle one-half the time and still earn sufficient to maintain a family for 365 days, which, if acceded to, must be distributed in increasing the cost of every commodity produced in any industry requiring steam power for its production, and in turn, the cost of living, of which we all complain so much.

I do not believe that prices or wages should be reduced to a pre-war level at the present time, if at all. Some changes have taken place in the world at large which we should recognize as a step forward and beneficial to all classes, requiring more money to maintain; this condition should be recognized and maintained up to the limit of our ability to maintain as a nation our industrial, social, financial, and political position in world relations. This condition cannot be accomplished successfully unless all classes alike, whether in the exchange of labor, the use of capital or political authority, work together under the advantages afforded us by our American institutions.

I believe the present policy of centralizing power by the international coal miners' union, requiring all outside districts to conform to wage and working conditions decided upon at a convention at Indianapolis in the Central Competitive Field where they are not represented, raises in the national coal industry the issue that was the cause of the American Revolution (taxation without representation); besides the loss of time by hundreds of our best miners and operators attending such conventions for weeks at a time, when the same results could be obtained in the several districts, where competitive production and conditions of labor are more uniform or the same. Wyoming, I have no doubt, would not be involved in the nation-wide strike if this condition were not in effect.

In proof of the statement that unreasonably high wages are not justified, and are of no economic advantage to the miner himself: In 1920–21 we were operating a lignite mine where, by reason of the natural advantages of a thick and pitching vein, 23 miners produced, when they worked, 600 to 650 tons per day; at the contract rate exacted by the union, a miner could earn and did earn as much as $20 per day, some more than that, some with an average of probably $13 to $15 a day. The mine worked only 151 days in 1921, while our other mines worked almost steadily. I could not induce the surplus men to accept employment in the mines that were working full time, because they could earn over $2600 a year by working two or three days a week at a lignite mine.

This coal was produced and sold to the public at practically one-half the price, and at less margin of profit than the average price of other coals. Had the labor cost been in proportion to the labor required for its production, it could have been sold much more cheaply, and the miners could have been employed 287 days at the other mines instead of 151 days at the lignite mine, and have earned a much greater sum, at a great advantage in production of coal which the markets required at that time. The miners, by this condition forced by the union, were encouraged to be idle at the expense of the public.

As to the stabilization of the coal industry, from a practical standpoint, I can now see but two possibilities that would, to some extent, relieve the situation of overproduction, namely: (1) To induce the union miners, or the men employed in the mines at the contract rates, to accept such prices per ton as would yield them a fair and satisfactory wage, applying reasonable industry and reasonable hours; (2) Since the leasing act of Government lands, a great many applications are being made and approved for new leases for the development of new mines, which will further increase overproduction and reduce the working time of the mines. This is within the power of the Government to regulate; before such leases are issued, a proper investigation should be held, or hearing, to determine whether the market where the proposed mine is to be opened requires the increased production contemplated by the new lease.

This suggestion does not apply to those already engaged in the business in territory adjoining public land; where the boundary has been reached, the lease should be extended to continue such operation, to prevent the destruction or the abandonment of capital assets and equipment.

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# Why does the Coal Industry Need Stabilization?

By GEORGE S. RICE

Chief Mining Engineer, United States Bureau of Mines, Washington, D. C.

SINCE my earliest recollection, the coal business has been in a state of unrest. It has always been a matter of bewilderment to the serious thinking, the instability of this most important industry; second only to agriculture in its effect on the great development of this country, and even more important in certain aspects, because without fuel railroads could not run, agriculture could not get its products to market, nor would the great manufacturing enterprises have been possible. I will not attempt to discuss the present serious labor dispute or similar disagreements of the past, in the settlement of which more or less successful attempts have been made to equalize, temporarily at least, natural conditions through "joint agreement" as to prices paid labor; but will confine my views to the general underlying conditions of which the disputes are symptoms, and try to show how these must be remedied before there can be any hope of stabilizing conditions.

## Our Coal Resources

The United States possesses about half of the coal resources of the world, and unlike conditions in Europe and many other parts of the world, the mining conditions are remarkably good. The coal lies high in elevation so that, except in limited areas in the Rocky Mountains, there is no deep mining, in the sense that there is deep mining in Europe. This has made it easy to open mines, and where the coal outcrops at the surface, as it does in the great majority of the coal districts, it becomes comparatively inexpensive to open new mines. The result has been that whenever there has been a special demand for coal, following periods of unusual prosperity, or following suspensions of work, in one part of the country, many new mines have been opened.

## Bituminous Industry

The business promoter has aided in the rapid development of new mines by securing options on coal rights from the farmers followed by the organizing of new mining concerns with the incentive of large return from a comparatively small investment. It has been a matter of comment that those relatively few men who have attained great wealth in the coal industry have not become rich through the production of coal, but by the buying, development and sale of coal lands.

The greatest problem of overdevelopment of coal-mining capacity arises with bituminous coal, of which this country has such vastly greater reserves than of anthracite. Fifty years ago the production of coal in the United States was insignificant as compared with the established coal industries in Great Britain and Germany, but with the rapid expansion of the bituminous industry, mines have multiplied and the production has nearly doubled every 15 years. Between 1900 and 1916 inclusive, the last year of normal production, the average annual increase in production of bituminous coal was 18,000,000 tons (2000 lb.). The number of men employed in the bituminous production rose from 304,000 to 561,000, which was not in proportion to the production, the saving in man power being effected by the rapid increase in the use and effectiveness of mining machines. During this same period, the number of days that the mines produced coal varied from 195 to 234, or an average of 217 days. Mines owned by railroads and large industrial establishments are generally developed to supply only minimum fuel requirements of their respective owners, and therefore usually work 300 or more days per year. On the other hand, most mines supplying the general trades work fewer days per year than the average figures given above. If all the bituminous mines worked 300 days in the year, the potential production in 1916 would have been larger by 150,000,000 tons, or 30 per cent. more than was actually produced—503,000,000 tons; this was in a year when the mines averaged 230 working days.

## Storage of Coal not the Panacea

The storage of coal has been much discussed, and recommended as a remedy. It is unquestionably a benefit in equalizing production and in preventing local shortages of coal in the winter months, but it is not a remedy for the manifest overproductive capacity of the mines and their employees. Its effect is that of a flywheel of an engine, not of the engine itself.

Every year a certain number of mines are worked out or abandoned from other causes. It is difficult to get at these figures precisely, as only limited statistics are available. Without going into details as to the source, the writer, during the period mentioned, estimated that the average lifetime of the bituminous mine was about 20 years, which would mean that in the year 1916 a production capacity of about 25,000,000 tons was lost. Assuming, for practical purposes, that this figure is

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roughly correct, an increase of the mining capacity is required of 25,000,000 tons for replacement, plus 18,000,000 tons, increase, in consumption rate, equal to 43,000,000 tons annually to take care of the constantly increasing bituminous consumption needs of the country.

We have already indicated that the estimated potential productive capacity of the mines, if they had worked 300 days in the year in 1916, was 150,000,000 tons in excess of that produced. If, therefore, no new mining capacity had been opened up following 1916, four years later the production capacity of the mines would have fallen below the normal increase in consumption of bituminous coal in the country.

It would not be wise or desirable to have no margin of capacity over consumption, so that even the restriction of new mining developments over a period of two or three years would bring about conditions where there would be comparatively steady work in the industry.

### Anthracite Situation

The situation in the anthracite districts of Pennsylvania is far more stable from an industrial standpoint, due to limited coal reserves. With these largely in the hands of strong mining companies, there is practically no opportunity for starting new enterprises in virgin districts, as in the case of bituminous coal. Accordingly, the annual increase of production has been relatively small. In the 10 years from 1907 to 1917, these years being selected as a normal decade of increasing production, the increased annual production was from 85,600,000 to 99,600,000 tons of 2000 lb., which is an average of but 1,400,000 increase for each year of that period. New mining developments therefore have produced little more tonnage than enough to replace the loss of production of abandoned and failing mines.

The annual increase of production, or even its maintenance, has been increasingly difficult despite the continued modernizing of mining equipment. This has resulted from the working out of the thicker coal beds, hence the necessity of mining thin and more impure beds, and the remining of old pillar workings. This, in turn, has necessitated the building and the operating of more elaborate cleaning plants for disposal of the impurity. Also, there has been an increasing quantity of water to be pumped from the mines as the extensive workings have fissured and caved, the ground thus admitting surface waters. In some instances the weight of the water elevated by pumping is over 10 times the weight of the coal hoisted. It must be admitted frankly that the peak of production of anthracite has been reached; it is possible that the production of 100,000,000 tons in 1917 represents the high mark, and hereafter there will be difficulty in again attaining this annual production even in years of prosperity. In fact, it is expected that in comparatively few years there will be a slow decline in production of anthracite.

The increasing difficulties of underground mining and cleaning necessitated such extensive mine power plants that over 10 per cent. of the production has to be used at the collieries in securing the shipped product. These increasing burdens are reflected in the increasing amount of labor and cost of supplies for production, without reference to the changes in the labor scale, hence it was inevitable that the selling price at the mine should increase, and the rate of increase must continue more rapidly than that of bituminous coal. Therefore, the anthracite industry does not reap the full benefit of the increasing consumption of the country, but, in fact, has had difficulty in holding markets which formerly it supplied exclusively. Anthracite has thus become a luxury. Nevertheless, in the period from 1907 to 1917 inclusive, the average number of days worked ranged from 200 to 285, or an unweighted average of 240 days as compared with 218 days for the bituminous mines. A matter of importance in favor of the stability of the anthracite industry arises through the relative uniformity of division of work which does not prevail in the bituminous industry; as between the bituminous mines owned by the railroads and large establishments to supply their fuel, and the bituminous mines supplying the general trade requirements which fluctuate widely in the different seasons. A factor which assists in the regularity of work at the anthracite mines is that anthracite may be stocked indefinitely without material degradation or danger of spontaneous firing.

### Further Consideration of Bituminous Mining

The foregoing discussion indicates that the greatest difficulties in stabilization arise in bituminous mining, in which there was a peak of production in 1918 of 579,000,000 tons and a drop to 407,000,000 tons in 1921, and under present conditions there seems to be no relief in sight, from too much mining capacity. Except for the period immediately following the war, when both the miners and owners profited greatly, the bituminous industry, statistics show, has had the lowest returns on capital invested and is the most unstabilized of the great industries of the country. Only exceptional bituminous mines supplying the general trade previous to the war paid reasonable returns over a period of years, and the record in many districts has been failure after failure.

Bituminous miners in most years up to 1917, and again in 1921, have suffered greatly in the shortage of work at different periods in the year. Miners and their families require food, clothing, and the necessities for 365 days in the year. If a man can get but half-time work, and a great proportion of the bituminous miners do not get more than this, he must receive at least double the minimum living daily wage to support himself and his family. The labor rates have been fixed on this basis so that tremendous inequalities are found between different groups of mines, and this in

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itself constitutes a tax upon the consumer and calls for what seems like excessively high daily wages compared with other industries. It must be considered that mining is a peculiar occupation. The miner must be on hand to take the work when it offers, and moreover, it tends to unfit him for other kinds of work, and rarely are there other kinds of work available in the vicinity on the days when the mine in which he works is idle.

The mine owner suffers from the irregularity of production. Even a small surplus of coal on the market rapidly drives down the selling price to cost price, or even below it in the periods of poor work. Generally it is not physically possible to store considerable quantities at the mine, and further, the loss from the weathering and degradation of bituminous coal and cost of handling is prohibitive when the price of coal is low. Storing at the place of use is admirable, but with exceptions this practically can only be done by the consumer and local distributor. Idleness of mines is a serious expense which is not realized by the public, but overhead charges, including taxes and processes such as pumping and ventilation, have to go on regardless of whether the mine is working or not; also, slacking of the roof and continuous ground movement, calling for timbering, is a continuing expense. Who bears the cost of this? Ultimately it must be the consumer. Under pre-war conditions, mine operations in Europe worked practically every working day in the year, and generally coal was hoisted on two shifts instead of the one 8-hour shift universally used in the United States with consequent idleness of an expensive mining plant of more than one-half of the 24 hours, every day. Metal mines of the United States always are expected to work at least two shifts per day.

### Six-hour Days and Five-day Weeks

Miners, from time to time, have proposed a six-hour day and five days a week in order to spread the work, but expect to receive a proportionally larger wage in order to obtain the same monthly or yearly income. Such attempts are surely wrong from an economic standpoint, and with the inevitable increase of mines under present conditions in this country, the relief would be but temporary and the burden of added cost would have to be borne by the consumer. What is the remedy? The hope of the writer, which has been expressed from time to time during several years past, is temporary restriction in the opening of new bituminous mines, in districts already over-supplied with mines, in order to lessen the burden of this tremendous economic loss from periods of idleness and to keep down the cost of producing the coal.

It is difficult for even intelligent people who have not studied the matter to understand that a greater number of mines does not mean greater competition, and hence lower prices. It does have this effect for short periods in the year, but looking at it in a broad way, the results previously described must inevitably make an increased cost of coal.

The Government has a similar problem in the leasing of coal lands on the public domain. Under the Act of Feb. 25, 1920, the Secretary of the Interior may lease or give permits to mine tracts of coal land not exceeding 2560 acres in the public domain. Congress in making the provisions of this Act did not take cognizance of the possibility of more mines being opened than would be needed. At the present rate of issuance, at the time of writing this statement, 190 leases, licenses, and permits have been approved for issuance. The territory to be served by the mines from the Rocky Mountains to the Pacific consumes only 40,000,000 tons of coal per annum, and the existing mines do not have full-time work. If developments proceed as leases are granted, except those in extension of existing mines, the new developments will have a potential productivity annually of a number of million tons, thus dividing a business already, in normal times, oversupplied, causing hardship to those already in the business, to the miners, dependent upon the mines, and creating a burden upon the respective mining communities. One of the effects already indicated due to over competition will be the mining of only the best and thickest of the coal beds, and perhaps losing, for all time, many areas of thinner and somewhat more impure coal surrounded by the abandoned workings of the thicker areas.

### Governmental Permission for Trackage to New Mines

In this case, the remedy is comparatively simple, that the Government should not issue a lease in any district unless it is shown to be needed for additional production in that district. How can the restraint of opening up new mines be affected in the far greater privately owned coal areas of the country? The writer's proposal is that this should be done through some such governmental agency as the Interstate Commerce Commission, which would require that before railroad trackage or interstate rates should be given to new mines the prospective operator should demonstrate to the Interstate Commerce Commission that there was need for additional mining capacity in the district he proposed to serve.

At first this proposal may seem to be a severe hardship on the owner of coal lands, but when it is considered that it would not be permanent restraint, but in most cases would be only for a period of several years, as indicated previously, then the owner would be recompensed by the greater stability of the business when he entered into it. Moreover, the plan would be based on the theory that it would be for the good of the greater number of citizens. To some, the method may smack somewhat of paternalism, but on the other hand, the Government, states and municipalities exercise restraint without destroying iniative or private control as in connection with public utilities. Fuel, theoretically

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at least, should be considered our greatest public utility. The plan is not altogether an untried one. Before the Sherman Act became a law, it was quite customary for certain railroads to discourage new developments on their lines already well served by coal mines. On such roads the work of the mines was more regular. On the other hand, mines on railroads that did not exercise such restraint were constantly in bankruptcy and the communities dependent on the mines suffered through the intermittent work. Again, during the war, the new mining developments were virtually under the control of the Fuel Administration and, despite the criticisms of the mine operators of some phases of that Administration, for the first time in the history of the bituminous industry, there was stabilization until the end of the war, and the operators had reasonable returns. It will be admitted that if the plan were carried out it would require very careful handling by the Interstate Commerce Commission to prevent injustice, but as it would be carried on probably through public hearings, and in effect court methods would be followed, it does not appear that it would be any more difficult a matter to settle than obtains in the determinations of important tariff rate changes between one part of the country and another.

In concluding, it is thought that, whatever may be the final settlement between the mine operators and miners, unless recognition is given to the need of a remedy for too many mines and too many miners, no settlement will bring about permanent stability in the industry. Attempts to equalize variations in natural conditions by fixing labor contract rates on the basis of the most difficult mining add to the cost of the consumer. The only way that low cost can be obtained is by keeping existing mines, and their employees steadily at work, not perhaps 100 per cent. of the possible working time but at least 85 or 90 per cent., in contrast with only 60 or 70 per cent., and in many districts less than 50 per cent.

The great development of this country has been founded on cheap coal and it is to the interest alike of owners and miners, as well as consumers, that the cost be kept low, with due regard to a decent scale of living for the miners and suitable returns to the owner for risking capital in a more or less hazardous business.

## The Coal Industry is Sick

By R. M. Atwater, Jr.*

THE trouble with the coal miners is part and parcel of the trouble with the coal business. The difficulty the public is having in getting a clear understanding of the rights and wrongs of the strike is due to the complication of many conditions bearing upon the situation which have passed beyond the control of the principals to the quarrel.

* Mining Engineer, New York City.

The coal-mining business, both anthracite and bituminous, has been built upon a foundation of unbusiness-like practices and expedients which, in many instances, were accepted as temporary and became permanent through extended usage.

The outstanding evils of the bituminous coal industry are, in my opinion:

1. Too many mines.
2. Too many miners.
3. Too much seasonal variation in consumption.

In the case of the hard coal mines:

1. Too many miners.
2. Too much seasonal variation.
3. Too much railway politics.

It is not difficult to find remedies for these troubles, the difficulty is to persuade the owners and workers to adopt the remedies. Legislation cannot solve the problem; nor can any overnight change bring about a solution.

The only suggestion that I will offer is that our Government confine its activities to asking the American Institute of Mining and Metallurgical Engineers to appoint a committee to advise the Government and, incidentally, to pay the committee properly for its work. The coal industry is very sick indeed, and it needs the care of specialists.

## Mine Strikers Accused of Undercutting Labor

A SPECIAL dispatch to the New York *Herald*, from Wilkes-Barre, on April 18, said that striking anthracite miners who were taking the places of men in other lines of endeavor were branded as "unfair workmen" by some of their own union leaders.

Alex. Campbell, member of the scale committee negotiating with the miners in New York, informed striking miners in the Pittston district that reports had reached him that strikers were taking jobs of laborers, cutting wages in some instances from 55 to 35 cents an hour.

"These men are unfair to organized labor," declared Campbell. "They are cutting the wages of other laboring men while clamoring for an increase in their own wages."

## A. R. E. A. Proceedings Wanted

THE Engineering Societies Library would like to have the Proceedings of the American Railway Engineering Association for 1918, 1919, and 1920. The Association cannot supply them. If any member of the Institute knows where these volumes can be obtained, he will confer a favor by writing to H. W. Craver, Director of the Library, 29 W. 39th St., New York, N. Y.

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# Untenable Position of Union in Coal Strike*

By EDWIN LUDLOW

Consulting Engineer, New York, N. Y.

THERE has been so much misinformation sent out through the newspapers, and I find so few people who are really acquainted with the true facts in regard to the coal strike, that I feel it would be advantageous to present the facts as I have been able to gather them.

One of the great points that the miners are now making is the fact that the operators of the central competitive field, consisting of the states of Illinois, Indiana, Ohio and Pennsylvania, have refused to meet them in a joint conference such as has been customary in previous years. There are two reasons why the operators declined to hold such a meeting. In the first place, the last time they held a meeting of this kind they were all indicted under the Sherman Act for making an agreement in restraint of trade. In the second place, the miners at their convention did not authorize their delegates to negotiate a new contract, but instructed them that nothing less than a scale based on the present wage, with the addition that there should be a six-hour day, a five-day week, time and a half for over time, and double time for Sundays, would be accepted. These additions would very much increase the cost of coal over the present wage scale. The operators could not consider renewing a contract on the present scale, as it would mean ruin for them, and as the miners were not authorized to negotiate a new scale on a fair basis that would enable the operators to mine coal in competition with the open-shop mines the operators did not feel that there was any use in meeting the delegates.

Thirty per cent. of the output of bituminous coal comes from the open-shop mines of West Virginia, Alabama and Pennsylvania. During the strike in 1919, this 30 per cent. was increased to 50 per cent. and it has affected the operations of the union mines to such an extent this year that they have been able to run only 15 to 30 per cent. of their time, while the open shop mines have run from 60 to 80 per cent. as the wages in these mines had been reduced to the 1917 scale.

The operators in Illinois and in Oklahoma have met with the miners and offered to negotiate a new scale, but the miners have advised them that they were without authority to make any scale of wages until the basic scale had been arranged in the four competitive states. The situation from the miners' union point of view is that they are not organized for any reduction of wages. Their organization is successful as long as they can continue to advance wages, but any retreat from the high wage scale which they have now acquired would cause dissatisfaction in the rank and file and probably the loss of leadership to the men who are now at the head of it. The proposition, therefore, is a simple one—the miners' leaders have put the scale on such a basis that the operators can not agree to it and when the present stocks of coal are exhausted they are confident that the Government will step in and form a commission which will arbitrate the differences, and if this commission should, as it probably would, insist on a lower wage scale the leaders of the miners could save their face by showing to the rank and file that the reduction was forced by the Government and not through their own negotiations.

### Operators Have Offered to Meet Miners

There is a probability, therefore, of a complete cessation of mining in the union fields until the present stocks are exhausted—possibly in 90 days—and then the real battle will begin; and the outcome of it depends entirely upon what action Washington may take. It has been claimed that the operators have gone into this fight for the purpose of breaking up the unions. There are no facts to sustain such a statement, as the operators in Oklahoma and in several other states have offered to meet their men and negotiate a scale, but the miners advised them that they were without authority to do so.

The only scale that will continue to be negotiated is the one in the anthracite region. Here the operators and the miners are both organized and have been since the Roosevelt Strike Commission which settled the five-month strike in that region in 1902. Their findings have formed a most valuable basis for negotiations; and decreed that all future disputes should be settled by a conciliation board consisting of three miners and three operators with a referee appointed by the court; that no suspension of mining would be permitted, but that any disputes must be presented before this conciliation board and if they were not able to agree it should be referred to the referee, whose decision should be final, and the award become retroactive to the date of the filing.

* Address before Tulsa Chamber of Commerce, March 31, 1922.

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This has practically prevented any serious strikes in the anthracite region since 1902, and these same members of the conciliation board, consisting of the three presidents of the three districts in the anthracite region and three operators, form the board that is now negotiating for a new wage scale. Two years ago they tried to negotiate a wage scale starting the ninth of March. No decision was arrived at although the discussions continued until the middle of September. An agreement, however, was made that the miners would continue at work and whatever award was made become retroactive to the first of April. Failing to reach any agreement in September, the Government appointed a commission which granted an award giving 20 per cent. advance in wages. The miners are now asking for another 20 per cent. advance and in order to meet this latter demand the anthracite operators have prepared themselves with facts through an entirely neutral and independent source; namely, the Federal Board of Industrial Research, which has made a careful study of the anthracite situation with comparisons between the wages and living conditions in 1921 and 1914. It finds that the increase in wages has been 160 per cent. to the anthracite miners as against 131 per cent. for the railroad men and 120 per cent. to industrial workers. Taking it on the basis of the cost of living and deducting the higher cost of living in 1921 as compared to 1914, it shows that the actual increase in wages has amounted to 60 per cent., and this figure is further checked by the savings accounts of the various banks in the anthracite region, which showed an increase of $75,000,000 during the last two years.

### Coal has Become a Luxury

There is no question, therefore, that the present wage in the anthracite region is more than ample and any advance over that would mean another increase in the cost of coal to the consumer. The anthracite operators have taken the position that they are willing to make a fair working agreement with their men to pay them a fair living wage, but that there must be a reduction from the present wages as they are now too high and the coal has become too expensive. It is considered a luxury rather than the necessity it should be for the people in the East who use that coal exclusively. Anthracite is used by the working people as well as by others and they should be furnished with coal at a reasonable price, which can not be done under the excessive wage that is now being paid.

In the bituminous field the basic wages are even higher. In Oklahoma outside day labor has been increased from $2.25 to $7.50. It is claimed that the high wages are needed on account of the short running time, but this is largely due to the high wage, which has made the cost for the coal so great that the territory in which it can be distributed has become restricted by the competition of the open-shop mines in Alabama and Colorado. The operators in Oklahoma can not afford to continue to pay the same wage and compete with the mines in surrounding states, and the people of Oklahoma are entitled to receive a cheaper coal which can be furnished only by the deflation of the miners' wage corresponding to the deflation which has already taken place in the earnings of the farmer, the metal miner, and, in fact, of workers in nearly every industry except that of coal mining.

This country must get back to work. It must return to a normal basis and it is not right that the farmer, the merchant, the professional man should have his living costs increased by the high price of fuel in order to maintain a wage higher than even the war wage to a certain class of miners. The cost of coal enters into the cost of nearly everything that is produced and it enters also into the cost of marketing the product of the farms, as fuel is one of the heavy expenses of railroads; a reduction in the cost of fuel is necessary as well as a reduction in the wages of the railroad men if freight rates are to be put back to a normal basis.

### Government Expected to Pay Losses

The facts in this case do not seem to be thoroughly understood. I think that if they are known, the public will not sympathize with the demands of the miners, and without public sympathy no strike can be successful It would be the part of wisdom to conserve as far as possible what coal supplies are now on hand, as the duration of the strike is very uncertain. It would be a misfortune if the Government should intervene, as it would be much better if the questions that are now at issue could be settled directly between the miners and the operators. We have had too much government intervention in business and every intervention of that kind has meant disorganization and higher costs.

The great desire of the miners is that the coal mines should be nationalized. I asked one of the district presidents why it was that they were so insistent on the nationalization of coal mines, when they could see that the nationalization of the railroads had not been a success and coal mines were more difficult to operate than railroads. The district president agreed with me that such was the case, but he said: "At the same time, the Government has given high wages and short hours to the railroad men and that is what we want, and we know that if the coal operators give us the short hours and high wages that we ask their overhead will be so great that they can not sell the coal at a price the public would be willing to pay, but if the Government will take over the mines they can sell the coal at any price they please, for the United States Treasury is strong enough to pay out any difference between cost and selling price." This socialistic argument is extremely dangerous; the whole country should appreciate this, and should put its stamp of disapproval on any tendency toward nationalization or toward Government intervention in the management of a basic industry of this country.

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# Abstracts of Institute Papers

The following papers will be printed in full in the TRANSACTIONS.
A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 24 of the Advertising Section. Discussion of papers is invited.

## Gas Absorption and Oxidation of Non-ferrous Metals*

BY B. WOYSKI AND JOHN W. BOECK, BUFFALO, N. Y.

MANY writers, in discussing defects caused by oxidation and gassing of bronzes and red brasses advocate substantially the same cure for both. But from its nature, oxidation cannot take place if there is an excess of fuel in the furnace, while the gases absorbed by some alloys are products of incomplete combustion of the fuel. Hence the metal can be either oxidized or gassed, but it is doubtful whether these actions can take place simultaneously.

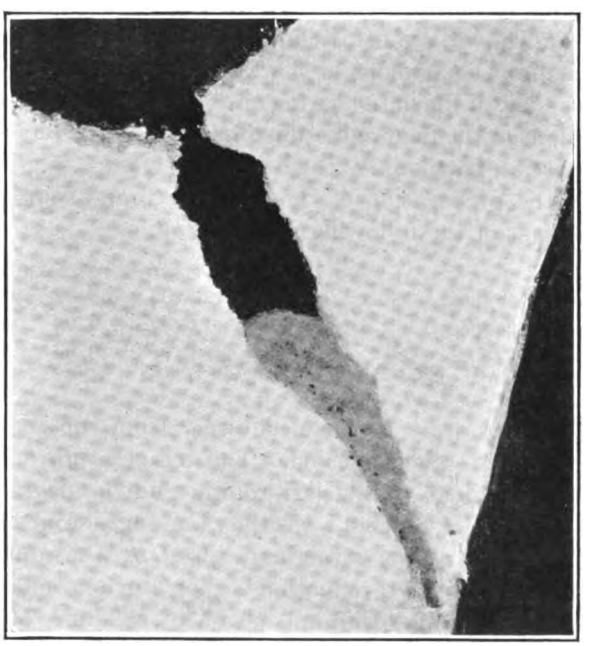
Oxidation can be easily overcome by the use of deoxidizers or it may be avoided by protecting the molten metal with suitable fluxes. Absorption of gases is more difficult to overcome. The regulation of the air and fuel, so as to produce complete combustion, and the protection of the bath by mineral fluxes are the most important factors. Gas expulsion, resulting in gas holes, porosity, unsoundness, and swollen or cauliflower-headed risers, is said to have several causes. One writer lists the most common causes in the order of their importance, as follows: Superheated metal, dirty or slaggy furnace conditions, using metals low in quality or those previously subjected to bad melting practice, poor grade of fuel, use of newly lined or damp ladles, indiscriminate mixing of scrap or illogical combinations of metal.

Superheating the metal usually occurs when the heat is ready to be poured but for some reason must be held in the furnace. In this case, a careful furnace tender tries to avoid overheating the metal by keeping a mild fire; that is, a reducing fire which, unfortunately, results in gassing the metal.

A dirty, slaggy furnace may result in gassing the metal by retarding the heating and prolonging the time necessary to bring the metal to the proper temperature, thereby increasing the chances of gassing in uncertain furnace atmosphere.

It is doubtful whether metals of low quality have anything to do with gassing molten metal, except possibly metals containing sulfur. The sulfur may produce gas holes as a result of a reaction with occluded oxides. The reaction between sulfur and copper oxide is reversible, depending on pressure and temperature.

Metal that has been subjected to bad melting practice, whether oxidized or gassed, can be brought back to normal conditions by proper furnace practice. In the case of oxidized metal, a deoxidizer or a flux is necessary. In the case of gassed metal, a strongly oxidizing furnace atmosphere of relatively high temperature, so as to produce quick melting, will correct the gassed condition. This has been proved many times. In one case, when, on account of a change in the furnace tender, several heats of red brass were gassed, all the castings were returned to the furnace and melted under the conditions just described, the resulting castings were entirely satisfactory, both as to fracture and microscopical examination.



LONGITUDINAL SECTION OF RISER OF A LARGE CASTING, SHOWING EXUDATION OF TIN-RICH ALLOYS.

The use of newly lined and damp ladles may be one cause of gassing. This may be ascribed to hydrogen, from dissociated steam, being absorbed and then liberated on freezing, or after action on the occluded oxides with the formation of steam at lower temperatures; although the dissociation of steam at the pouring temperature of bronzes is negligible.

* Rochester Meeting, June, 1922.

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Indiscriminate mixing of scrap and the illogical combination of metals should never occur in any foundry, but we hardly believe that it would result in gassed metal.

From these practical observations it can be concluced that:

The most important cause of gassing molten metal is the furnace atmosphere. Gassed metal can be brought back to normal condition by remelting in an oxidizing atmosphere. A reducing atmosphere is more troublesome than an oxidizing one. Defects caused by gas or shrinkage may have a similar appearance to those caused by oxidation and are often mistaken for such.

## Physical Properties of Cartridge Brass*

By C. Upthegrove and W. G. Harbert, Ann Arbor, Mich.

During the past year considerable work dealing with physical properties of cartridge brass was done at the University of Michigan in cooperation with the Ordnance Department of the U. S. Army. This paper gives some of the data bearing on the effect of the anneal, previous to the final reduction or rolling, on the physical properties, particularly the hardness.

In the preparation of the cartridge brass, four bars were cast of the following composition:

| | No.1 | No.2 | No.3 | No.4 |
|---|---|---|---|---|
| Copper, per cent | 68.42 | 68.09 | 68.54 | 68.45 |
| Lead, per cent | 0.03 | 0.02 | 0.02 | 0.02 |
| Iron, per cent | 0.02 | 0.03 | 0.02 | 0.03 |
| Zinc, per cent | 31.53 | 31.86 | 31.42 | 31.50 |

The bars were overhauled direct from the casting shop, rolled and annealed. The temperature of the anneal previous to the last rolling and the degree of reduction, 37.1 per cent., was the same for all four bars.

The difference in structure caused by the anneals previous to the final reduction is shown in photomicrographs. Following the anneals at 570°, 650° and 750° C. the bars were all rolled to 0.134 in. Following the reductions, the bars were cut into 10- by 1-in. strips. From this point the annealing treatment was similar to that used by Bassett and Davis, the bars being annealed at 50° intervals from 200° to 750° C. and at 25° intervals from 250° to 325° C. A 3-in. piece was cut from each bar, for microscopic examination and Brinell tests.

### Conclusions

For low-temperature anneals, following reduction by rolling, the Brinell hardness of cartridge brass is appreciably influenced by the anneal previous to the rolling.

This influence decreases as the degree of reduction in rolling is increased.

For low-temperature anneals following reduction by rolling, the tensile strength and elongation are influenced, though to a lesser degree than the Brinell hardness, by the anneal previous to the rolling.

For cartridge brass annealed at temperatures of 650° C., or above, after reduction by rolling, the Brinell hardness, tensile strength, and elongation are independent of the anneal previous to the rolling.

* Rochester Meeting, June, 1922.

## Some Electrical Properties of Nickel and Monel Wires

By M. A. Hunter, F. M. Sebast, and A. Jones, Troy, N. Y.

This paper gives the results of an investigation of the specific resistance and temperature coefficient of the electrical resistance of nickel and its important alloy, monel metal. For most of the pure metals, the temperature coefficient of resistance is approximately 0.0004 per degree centigrade at 20° C. Nickel and iron, however, are exceptions. This property is important as it gives good material for the construction of thermometers and other instruments involving electrical control.

A summary of information on this subject has been published by the Bureau of Standards. The present experiments antedate this publication by several years and as the information obtained is not contained in it, the results of the experiments are published as additional information.

These experiments indicate the conditions that must be observed to secure a nickel wire with the highest possible temperature coefficient of electrical resistance. The nickel must be the finest available. The additions of manganese must be as small as compatible with subsequent forgeability. The time taken to melt should be a minimum, in order that the molten material shall be exposed for as short a period as possible to the effect of furnace gases. If these conditions are met, a high-grade nickel wire can be readily produced.

### Commercial Alloys of Nickel

Malleable nickel ingots are produced in several grades. The most important are grades A, C, and D nickel. In view of the fact that nickel has a high temperature coefficient at low temperatures and also a high resistance to oxidation at high temperatures, it was thought advisable to investigate the temperature coefficient of the material at high temperature. To this end, the resistances of samples of these various materials were measured over the range from 20° to 1000° C.

Monel metal, an alloy containing 67 per cent. nickel, 28 per cent. copper and 5 per cent. other metals (chiefly iron, manganese and silicon) is similar to nickel in that it has a high temperature coefficient, so a sample of this material was subjected to the same investigation. Exact analyses of the materials used are not at present completed, but will be added to the report.

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SUMMARY

Pure nickel with a low specific resistance and high temperature coefficient may be produced by melting electrolytic nickel with the addition of a minimum amount of manganese. The time for melting is a material factor in the production. The effect of various impurities is also indicated.

The variation of resistance with temperature for various grades of commercial nickel and of monel metal were investigated and from the resistance temperatures curves, the transformation points were obtained.

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## Occurrence of Blue Constituent in High-strength Manganese Bronze*

BY E. H. DIX, JR., DAYTON, OHIO

DURING an investigation on high-strength manganese bronze by the Engineering Division of the Air Service, at McCook Field, Dayton, Ohio, particles of a "blue constituent" were noted in the microstructure of most of the bronzes examined.

The constitution of the simple copper-zinc base alloy is still a matter of dispute in spite of the fact that the copper-zinc series is one of the oldest industrially important groups of alloys, and has received the early consideration of scientific research. The diagram according to the most recent work, is shown in the original paper.

The disputed questions involve termination of the beta field and the line at 470° C. The earliest experimenter, Roberts-Austin, detected an arrest in some of his cooling curves at approximately this temperature and ascribed them to the formation of a eutectic; it has since been proved that there are no eutectics in this series. Shepherd was unable to detect any thermal arrests at this temperature; his diagram was essentially as shown, except that the line at 470° C. was omitted and the beta phase carried down to normal temperatures. Later, Carpenter and Edwards, by a very painstaking research, definitely established the authenticity of the line but attributed it to the breakdown of the beta constituent into a eutectoid of alpha and gamma. Microscopic evidence of the formation of the eutectoid is doubtful and it seems more likely to be due to an allotropic change in the beta constituent. At least for practical purposes, it is more convenient to think of the structure of a 60–40 brass as a mixture of alpha and beta prime crystals rather than alpha plus an unresolvable eutectoid of "apparent beta" as it has often been called.

Manganese bronze consists of a 60–40 copper-zinc base alloy, to which is added small quantities of each of the elements, tin, aluminum, iron, and manganese. Usually the percentage of any one of the elements added is so small that, if added alone, it would be taken into solution and the only effect on the structure would be to give more beta prime and less alpha than would be expected for the true zinc content. This effect can be satisfactorily estimated by the use of Guillet's "fictitious zinc" calculation. However, when even these small percentages of the four elements are added in the same alloy, the joint effect often produces small regular particles of a third constituent of a characteristic blue color. That these particles are much harder than the alpha-beta prime matrix is shown by an examination of the polished surface unetched. They stand out in relief. Contrary to the findings of the experiments previously reviewed, in which the appearance of a special constituent was accompanied by a severe reduction in the elongation, a moderate amount of this constituent is found in ductile manganese bronze (having an elongation of at least 30 per cent.) and a considerable amount is usually present in particularly high-strength manganese bronze (over 80,000 lb. per sq. in. tensile strength).

When the hardening elements (aluminum, tin, iron, and manganese) are added to the 60–40 copper-zinc alloy in sufficient quantities to produce a high-strength manganese bronze, a third constituent appears in the alpha-beta prime complex, which has a characteristic clear blue color.

The occurrence of this constituent in reasonable amounts is not necessarily accompanied by brittleness.

Annealing for 7¾ hr. at 1560° F., followed by either water quenching or slow cooling, does not cause the disappearance of this constituent.

This constituent, when examined unetched, appears to be of a deeper blue than either the delta constituent of the copper-tin series or the gamma constituent of the copper-zinc series. When etched with $NH_4OH$ plus $H_2O_2$, the blue constituent is unattacked except for a slight eating away at the edges under prolonged etching, whereas the gamma constituent with the same reagent is immediately tarnished and rapidly dissolved. The characteristic shape of the blue constituent is decidedly different from that of the delta of the copper-tin alloys.

For practical purposes in the study of the microstructure of manganese bronzes, it seems highly desirable to regard the blue constituent as distinct from either the delta or gamma, and it is suggested that it may reasonably be denoted as delta prime.

In the manufacture of manganese bronze, the particles of delta prime are precipitated from the copper-rich solid solution by the addition of the zinc. This precipitation is strongly influenced by the presence of iron and, therefore, the particles probably consist of a solid solution of iron and copper with or without some tin, aluminum or manganese.

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* Rochester Meeting, June, 1922.

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# An Inventory of Results of Accident Prevention*

C. A. Allen, Salt Lake City, Utah

FOR over three years, we have been endeavoring to reduce the number of fatalities and minor accidents in Utah. The physical condition of the mines, concentrators, and smelters is good, yet the number of accidents, especially in the coal mines, has been much higher than it should be; though compared with all the mines of the United States, the metal-mine accident rate has been good. This has been a source of wonder to us; we are proud of the physical condition of our coal mines, just as much as of our metal mines, and have a number developed along the most modern lines. We believe that, taking the state as a whole, we have just as good coal mines as any state in the Union.

Considering the efforts in safety work during these years, conditions do not show the improvement they should. Every fatality in Utah is investigated by a mine inspector, and their reports were carefully gone over in an effort to place the responsibility for the deaths. Out of 57 fatalities in the mines, quarries, mills, and smelters, in 1919 and 1920, the responsibility could be placed about as follows:

| | Open-pit Mines and Quarries, Per Cent. | Underground Mines, Per Cent. | Mills and Smelters, Per Cent. |
|---|---|---|---|
| Fatalities due to conditions that could have been avoided by companies | 30 | 6½ | 30 |
| Laxness of foremen or bosses, in some cases shared by man killed | | 16 | |
| Fault of fellow employees | 40 | 6½ | |
| Carelessness of man killed | 10 | 29 | 20 |
| Purely accidental | 20 | 42 | 50 |

Out of 63 fatalities in the coal mines in 1919 and 1920 we placed the responsibility as follows:

| | Per Cent |
|---|---|
| Fault of man killed | 39 |
| Due to conditions that could have been avoided by company | 9 |
| Fault of fellow employee | 11 |
| Purely accidental | 41 |

Some of the largest mines had comparatively low accident rates, but most of them had more efficient safety inspection and instruction and had steady employees, which outweighed the advantages of the smaller mines.

During 1920, accidents were more numerous than in the years preceding or following. For most of the year, men were not plentiful, there was a large demand for coal, and the men were making extremely high wages.

A careful study of the results shown, by investigation and collection of data taken in conjunction with other information, led to the following conclusions:

1. The men are responsible for most of the accidents and efforts to reduce the number of accidents must take this fact into consideration. While there is a large proportion of good, careful, efficient, conscientious workmen, too large a percentage of the men, unfortunately are not of this type and they are the ones toward whom our efforts must be directed.

2. A mine, or more especially a plant, having the best physical condition may have the highest accident rate. When a plant is well provided with safeguards, there is a tendency for some men to become careless and to consider the safeguards as an excuse for less care and sometimes as an object of ridicule.

3. Other things being equal, small mines have proportionately fewer accidents than large mines.

4. The efficiency and ability of the mine management is one of the most decisive factors in the prevention of accidents. When a good foreman can maintain proper discipline regarding safety measures, accidents will be few.

5. Since the passage of compensation laws by the various states, there has been a marked increase in the number of minor accidents reported. While the great benefit of these laws has been most thoroughly proved, men of a certain type have taken advantage of the laws to lay off from work when they would not have done so if they were not to receive compensation. It is also not unreasonable to assume that the knowledge that they will receive a monetary consideration if they are injured has a tendency to make some men more careless.

6. When labor is scarce and wages are high too many men will refuse to recognize safety regulations and accidents increase.

The number of fatalities in mining in Utah during 1921 was lower per thousand employed than the average of the last seven years. No doubt, some credit must be given to this safety campaign; it enlisted the efforts of the foremen and the good miners, and due to the plentiful supply of men, the foremen were enabled to enforce strict discipline. This was also the first year in which the coal mines were brought up to the standards of the new safety regulations accepted by the operators and the state in 1920. The results of a campaign of this kind, however, are but transitory, and something more permanent is necessary. Training of a large percentage of our miners is imperative before accident prevention will attain its ultimate success; the methods for doing this have not been fully developed. The following methods seem the most likely to result in success:

1. The principles of safety and efficiency should be inculcated in the minds of the school children in the mining camps; also the spirit of taking pride in their work.

2. The apprentice system should be adopted wherever the conditions of the work will permit. By paying the apprentice less money, the skilled man may receive more without increasing the total cost of the products.

3. In British Columbia, a man must pass an examination before he can work as a miner and receive first-class

* New York Meeting, February, 1922.

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miners' wages; this is essentially the apprentice system applied underground.

4. Probably the most effective way to train men and get immediate results is through the foreman and any way of increasing his knowledge or his ability to impart it is a step in the right direction.

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## Systems of Mining in Pocahontas Coal Field and Recoveries Obtained*

By Thomas H. Clagett, Bluefield, W. Va.

THE Pocahontas coal field comprises the area in Tazewell County, Va., and Mercer and McDowell Counties, W. Va., in which Nos. 3 and 4 Pocahontas seams of bituminous coal are mined. It is a mountainous region with ridges rising 300 to 1000 ft. above the very narrow valleys and, except some poorly kept farms along the tops of the ridges and the area occupied by the mining and coking plants and villages, is wooded throughout.

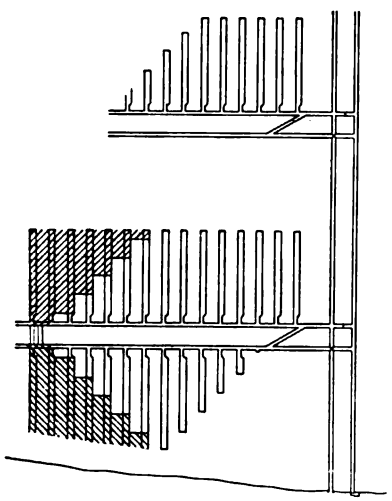

Fig. 1.—System of mining forming part of early leases.

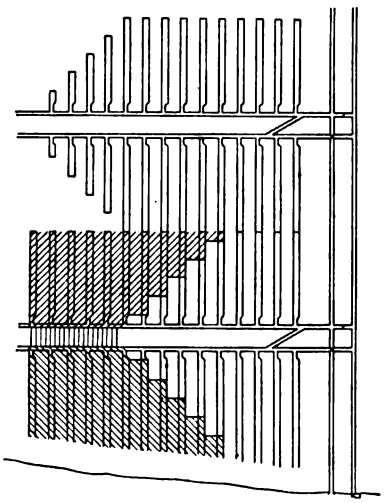

Fig. 2.—Second system of mining used.

No. 3 seam is from 4 to 10 ft. thick, but the change is gradual and the thickness fairly uniform in any particular locality. It has a streak of bone, about 2 in. thick, to which the coal adheres on both sides. In parts of the field this bone is replaced by hard slate, usually from 2 to 4 in. thick. The seam has a slate or fireclay bottom and a draw-slate top.

No. 4 seam is from 65 to 80 ft. above No. 3 seam, and of minable section only in the western part of the field. It is from 3 to 8 ft. thick and has two streaks of bone, each from 1 to 2 in. thick. It has a fireclay or slate bottom and is overlaid by from 4 to 24 in. of a laminated coal and slate, locally termed "black rash," which is separated from the coal seam by about 3 in. of slate. This "black rash" averages about 25 per cent. ash, but contains some clean coal.

The coal in both seams is quite soft. Cleavage sufficiently well defined to exert an influence on the mining is rare. Overlying strata are slates, shales, and sandstones, the sandstones predominating, extending from 30 to 1000 ft. above No. 3 seam. The strata directly above the draw slate of No. 3 seam, or "black rash" of No. 4 seam, and up to the first sandstone are usually slates or shales, about 10 ft. thick over the thicker coal, decreasing in thickness as the coal becomes thinner, and sometimes disappearing altogether. The dip of the seams is usually sufficient to provide natural drainage, although there are many undulations, swags, and basins requiring pumping and ditching. Explosive gas is rarely found except in the slope and shaft workings. The land as a rule, including the surface, is owned by land-holding companies and leased to operating companies on a royalty basis.

### Mining Method Used

The room-and-pillar system of mining has been used from the beginning, the principal changes in the manner of its adaptation as mining progressed are shown by the accompanying sketches. Fig. 1 shows the system of mining that was made a part of many of the earlier leases. It provided that entries and break throughs should be 10 ft. wide, entry pillars 60 ft. wide, rooms 18 ft. wide, and room pillars 42 ft. wide; that rooms from one entry of a pair should be turned and worked out progressively on the advance; that rooms from the other entry should be turned and worked out progressively on the retreat; and that pillar mining should be deferred until the entries had been driven the intended distance and then begin in the last pillars and conducted on the retreat in both sets of pillars, the chain pillar of the entry being

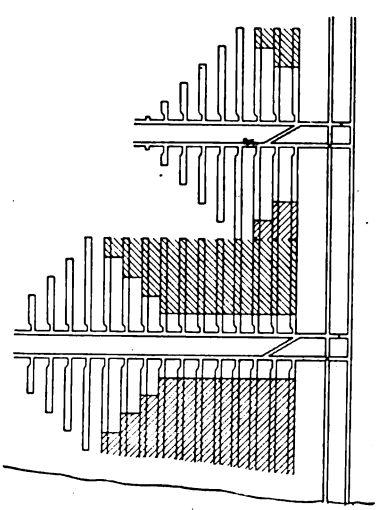

Fig. 3.—Drawing pillars on the advance.

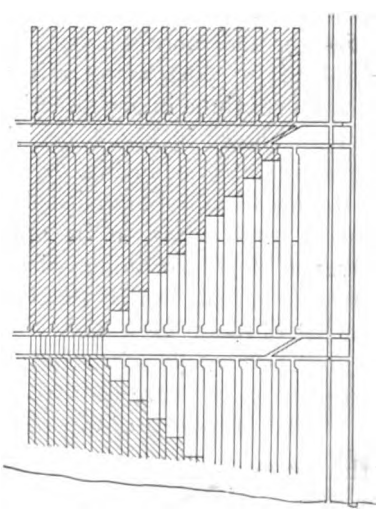

Fig. 4.—Pillar-drawing method used later.

* New York Meeting, February, 1922.

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mined at the same time. In but few instances was this system carried out, apparently because of the desire for immediate tonnage.

The first change was to work out rooms from both entries on the advance (Fig. 2); with few exceptions this system was followed for a number of years.

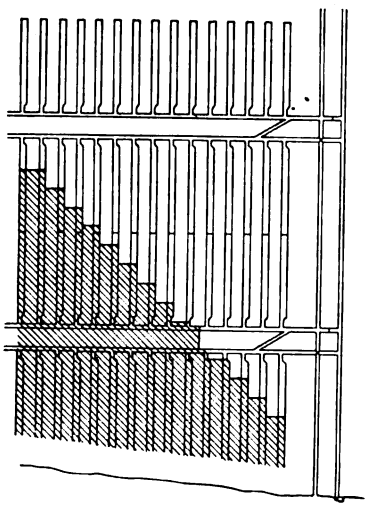

FIG. 5.—PILLAR-DRAWING METHOD USED WHEN GRADES ARE FAVORABLE.

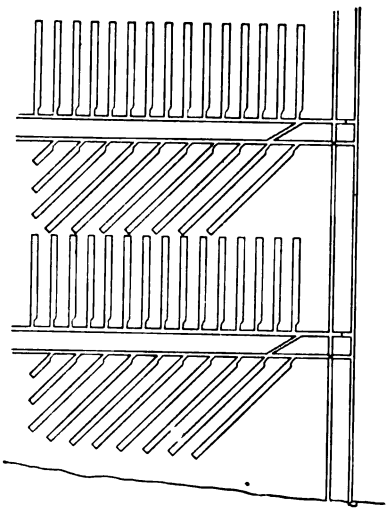

FIG. 6.

An effort was made to avoid the losses and inconvenience caused by the delay in pillar mining by mining pillars on the advance, as shown in Fig. 3; but, unless the rooms were unusually long and the cover light, the area opened was not sufficient to cause a break of the overlying sandstones and a squeeze usually followed. This caused a loss of the entry stumps and chain pillar and the squeeze spread to adjacent areas when opened up.

Longer and more uniform break lines were obtained by postponing pillar mining until it could continue in one direction over a larger area, as shown in Fig. 4, or, when the grades were favorable, as in Fig. 5.

Rooms from both entries of a pair not only caused large areas to be opened up far in advance of pillar mining, with probability of losses as stated, but frequently required that one set of rooms be worked to the dip, or else at an acute angle with the entry, in an attempt to keep above the strike line, as shown in Fig. 6. Progress of dip rooms was usually delayed by water while changes in direction of rooms caused irregular break lines in pillar mining. The working of rooms from both entries of a pair was therefore discontinued, as a general practice, in favor of working rooms from one entry only (see Figs. 7 and 8), and although many mines continued to turn and work all rooms on the advance, others first drove room entries to completion and then turned and worked out the rooms progressively on the retreat, followed promptly by pillar mining as indicated.

There were other changes from time to time and a variety of combinations as regards width, length, and spacing of rooms, but experience and a study of methods of other fields had shown that economical pillar mining and a maximum recovery of coal required that rooms be opened up only fast enough to provide for the uninterrupted advance of pillar mining; that pillars be mined promptly upon completion of rooms; that the line of pillar mining be carried forward uniformly in one direction until sufficient area was completely mined out to cause a good break of the overlying sandstones; that the direction of the break line be varied as little as possible, within reasonable limits, and that barrier and other pillars be of sufficient size not only to protect the workings properly but to admit of their being satisfactorily mined later. Most new development since 1900 has been laid out with these principles in mind.

## An Outline for Papers on Mining Methods. Compiled by the Mining Methods Committee*

THE Mining Methods Committee during the past year has spent much of its time developing the interest of members of the Institute in the work that comes under its direction. The response on the part of the membership has been most encouraging and in order to give a concrete form to the program which it hopes to develop, an "Outline for Papers on Mining Methods" has been drawn up and submitted for consideration. This outline has slowly taken shape until it represents ideas contributed by a great many men, and it is hoped that it will be suggestive and helpful in the preparation of papers.

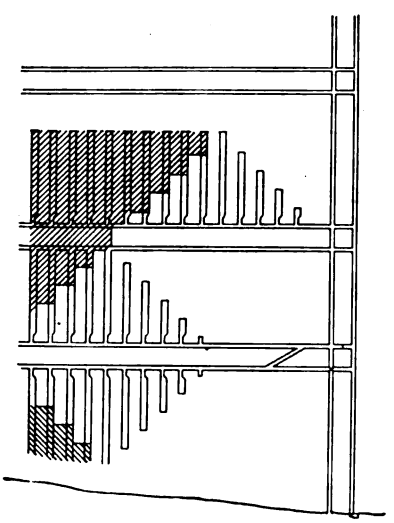

FIG. 7.

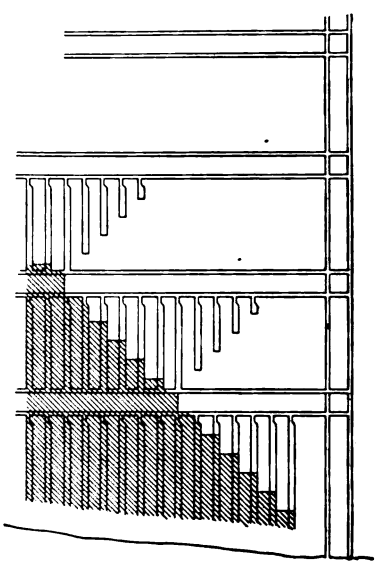

FIG. 8.

* New York Meeting, February, 1922.

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# Personal Notes and Biographies

**Frank Maloit, Jr.** is with the Empire Zinc Co. at Gilman, Colo.

**E. L. Miller, Jr.** is teaching at the Missouri School of Mines, Rolla, Mo.

**Arthur L. Endress** is with the Spar Mountain Mining Co., Cave-in-Rock, Ill.

**B. W. Knowles** is superintendent of the Nickel Plate mine, at Hedley, B. C.

**Louis B. Benton** is geologist with the Humble Oil & Refining Co., Ardmore, Okla.

**Herbert N. Witt** is consulting geologist with Thebo, Starr and Anderton, San Francisco.

**Earle G. Morgan** is assistant general manager of the Abangarez Gold Fields of Costa Rica.

**C. L. Boeke** is with the San Francisco Mines of Mexico, Ltd., at Parral, Chih., Mexico.

**John A. Quigley** is at Camp Verde, Ariz., with the Yavapai County Highway Commission.

**Edel Moldenke,** of Watchung, N. J., is with the Southern Spar & Mica Co., Swannanoa, N. C.

**Arthur L. Harris** has returned from La Vega, Dominican Republic, and is now at Dillsboro, N. C.

**D. A. Powell** is in the diamond-drilling department of the Cortez Oil Corpn., at Tampico, Tamps, Mexico.

**David D. Irwin** has left Mexico and is now with the Phelps-Dodge Corpn,. Copper Queen Branch, Bisbee, Ariz.

**Richardson T. Wilder** is superintendent of the Mazapil Copper Co., Ltd., Concepcion del Oro, Zacs., Mexico.

**Chester W. Washburne** lectured on the principles of oil geology at Harvard University during the last week of March.

**E. L. Beck** is a member of the firm of Siler & Beck, Engineers & Contractors, with offices in the Martin Bldg., Mexia, Texas.

**D. W. Butner,** who has been in the Belgian Congo for some time, has returned to the United States and is at Colorado Springs, Colo.

**S. Paul Ward,** recently returned from South America, is smelter superintendent with the Shasta Zinc & Copper Co., at Winthrop, California.

**C. W. Van Law,** recently with the Union Petroleum Co., Philadelphia, has opened an office for consulting work, in the Woolworth Bldg., New York City.

**Walter G. Perkins** and **Preston K. Horner** have opened an office for consulting work as mining and metallurgical engineers, at 62 London Wall, London, England.

**Dean E. Winchester** has opened a consulting office in the Ernest and Cranmer Bldg., Denver, Colo., to handle geological investigations of petroleum, oil shale and coal properties.

**Fletcher H. Wood,** who has been with the Transcontinental Petroleum Co., Panuco, Vera Cruz, Mexico, is now with the Cia. de Gas y Combustible Imperio, S. A. at the same place.

**Henry S. Burnholz** has been appointed mining engineer on the special drill-steel investigation being conducted under the joint supervision of the U. S. Bureau of Mines and Bureau of Standards.

**L. Reinecke** expects to begin practice in Johannesburg very soon, as a mining geologist and topographer. At present, his address is Ceres, Cape Province, South Africa, in care of Rev. D. M. Reinecke.

**Robert Linton,** chairman of the New York Section, was a guest of the Pittsburgh Section at a dinner on March 28. Later in the evening, Mr. Linton addressed the Mining and Metallurgical Section of the Engineers' Society of Western Pennsylvania.

**Alfred Paul Grossman,** formerly junior mining engineer with the Empire Steel and Iron Co. at its Mount Hope mine, New Jersey, is now with the Massachusetts Highway Commission, Department of Public Works, as resident engineer at Middleboro.

**Robert C. Stanley,** formerly first vice-president of The International Nickel Co., was recently elected president. Mr. Stanley has ordered a reorganization of personnel, involving as its chief feature a new department of Development and Research with headquarters at 67 Wall St., New York City. This department will be under the direction of **A. J. Wadhams,** as manager. Associated with him will be **Paul D. Merica,** director of research.

**B. Britton Gottsberger** has been elected professor of mining by the Yale Corporation and will assume his duties as a member of the Yale University faculty at the beginning of the academic year next fall. Since the resignation of Prof. James F. McClelland in 1919, there has been no professor of mining in Yale University.

Mr. Gottsberger was born in Brooklyn, in 1874; he

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received his education at the Brooklyn Polytechnic Institute and at the School of Mines of Columbia University, where he received the degree of E.M. in 1895. After an unusually varied experience as assayer, surveyor and engineer in Central America and Mexico, Mr. Gottsberger went to the Tennessee Copper Co. in 1900, and ultimately rose to the position of general manager. In 1909, he became general manager of the Miami Copper Co. He resigned that position in 1919, to engage in consulting work, and since August, 1921, has been secretary of the Mining and Metallurgical Society of America.

Few men have to their credit as brilliant a managing record as he has established during his 20 years of experience in the management of big companies. He is considered by those who have been intimately associated with him as one of the best qualified American mining engineers who could be chosen for the task of developing a department in Yale University.

**E. C. Reeder,** for the past five years chief engineer of the Rosiclare Lead and Fluor Spar Mining Co., at Rosiclare, Ill., resigned that positson on March 1, to enter the employ of the Hillside Fluor Spar Mines, of the same place, in a similar capacity.

## Samuel McClure

SAMUEL McCLURE, second vice president and general manager of the Stewart Furnace Co., and for nearly half a century identified with the iron and steel industry in the Shenango Valley, died at his home in Sharon, Pa., on March 25.

Mr. McClure was born on Jan. 3, 1839, in Little Beaver Township, Beaver County, Pa. His father was a merchant contractor and farmer, his mother was the daughter of Samuel and Mary (Custer) Clark, of the same family as the famous General Custer.

Samuel McClure received a public school education, and attended Girard Academy, at Girard, Pa. He started work on a farm and also clerked in his father's store. In 1862, he entered the employ of James Wood and Son of Pittsburgh and was sent by that firm to its Homewood furnace, Lawrence County, to take over the management of a store.

In 1863, Mr. McClure's career in the iron and steel industry began as cashier, bookkeeper and later superintendent and manager of the James Wood & Son Company's furnace in Wheatland, Pa. He remained in Wheatland until 1873, when he went to West Middlesex to manage a blast furnace.

In January, 1874, he went to Sharon as superintendent of the Stewart Iron Co., Ltd., which about a year ago became the Stewart Furnace Co. He acquired an interest in the company in October, 1889, and was elected to the board of managers. He was also general manager of the iron business of the company in the Shenango Valley and of the coking interests at Uniontown, Pa. During the same period he was made president of the Shenango Machine Co. of Sharon.

In association with the late F. H. Buhl and the late Daniel Eagan in 1886, Mr. McClure assisted in the organization of the Sharon Steel Casting Co. and was elected vice president. This company was later acquired by the American Steel Casting Co., which in 1902 became a constituent company of the American Steel Foundries.

Until the merger of the Sharon Savings & Trust Co. with the McDowell National Bank several months ago, Mr. McClure was president of the former banking organization. He had been a member of the Board of Directors of the Savings & Trust company since its early history.

Mr. McClure was also president of the Sharon Railway Co., president of the Union Limestone Co., of Youngstown, O., president of the Board of Trustees of the F. H. Buhl Farm, president of the Christian H. Buhl Hospital.

Mr. McClure was a staunch Republican and representative of the then Forty-seventh District as State Senator in 1884.

He was a member of the American Institute of Mining and Metallurgical Engineers, and of the American Iron and Steel Institute.

He was married on July 1, 1863, to Augusta R. Dickson of Clarksville, Pa. Mrs. McClure died in 1921.

Surviving are three daughters: Mrs. Charles F. Phillips, and Mrs. C. C. Marshall, of Sharon; Mrs. D. M. Forker, of Cincinnati, O.; one brother, Thomas McClure of Meadville, Pa.; two sisters, Mrs. Frank Jones and Miss Sara McClure, both of Clarksville, Pa., and ten grandchildren.

## Philip Argall

PHILIP ARGALL, on his father's side, was descended from a Cornish mining family; his mother was Scotch-Irish. He was born in Newtownards, County Down, Ireland, in 1854, came to America in 1887, and was naturalized in 1889.

Mr. Argall finished grammar school when he was sixteen, and went to work in the dressing works of the Tigroney mine. He studied mathematics and surveying under a tutor, and was given friendly help by professors at the Royal College of Science for Ireland, in Dublin, who were interested in his ambition. When he was 20 years old, he bought a second-hand laboratory equipment, and in 1879 he took a course in metallurgy at Swansea, Wales. He also worked at all kinds of mining, and in 1875 was assistant manager of the Cronebane mine, with the title of Captain, according to Cornish practice.

After varied experience in metallurgical plants and mines in Ireland, Cornwall and Wales, he went, in 1883, to New Zealand, as manager of mines at Coromandel

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for the Kapanga Gold Mining Co. He spent about a year in New Zealand, then made some examinations in France, and in 1886 became superintendent of the Los Bronces and Animas mines in Mexico.

At the end of 1886, he became consulting engineer to the Mountcashel Iron Ore Co., Antrim, Ireland; also to the Société Anonyme de Plomb d'Aspérières, operating on the river Lot, France. He was working on a concentrating mill for the former when he was offered the position of manager of La Plata smelter at Leadville, Colo., in March, 1887.

Mr. Argall's work after he came to the United States was in various fields of mining and metallurgy. He traveled extensively in Mexico, from 1903 to 1907, and in 1905–06 had charge of the field work of the Zinc Commission appointed by the Government of Canada to investigate the zinc resources of British Columbia and test the ores to determine the best commercial process for their beneficiation.

In 1876, Mr. Argall married Miss Frances Oates, of Avoca, Ireland. They had five sons, two of whom formed a partnership with their father several years ago, under the name of Philip Argall & Sons. The offices of the firm were in Denver, Colo.

Mr. Argall died on March 19, 1922.

## Knox Taylor

KNOX TAYLOR, president of the Taylor-Wharton Iron and Steel Co., died at his home in High Bridge, N. J., on April 4. He was of the fifth generation of his family in the management of the industry which was founded in 1742.

Mr. Taylor was born at High Bridge on Oct. 19, 1873, son of the late William Johnston Taylor and of Mary Alward Taylor. He began his education at Chester, N. J., where for a time his father operated an iron blast furnace; later he attended the Hill School at Pottstown, Pa., the Model School at Trenton, and was graduated from Princeton University with the degree of Bachelor of Science in 1895. In college he was a member of the track athletic and football teams, and was selected as all-American guard. His love of outdoor life led him to engage in mining engineering work in the Rocky Mountains for seven years after leaving college.

In 1902, he returned from the West to enter the employ of the Taylor Iron and Steel Co. He began at the bottom and worked up through various departments in the foundry and the old wheel shop, until he became general manager in October, 1905. Five years later he became president of the company.

In 1912, the Taylor company purchased all the interests of William Wharton, Jr. & Co., Inc., of Philadelphia, and its subsidiary, the Philadelphia Roll & Machine Co. and the combination became known as the Taylor-Wharton Iron & Steel Co. In 1913, the company bought out the interests of the Tioga Iron & Steel Co. at Philadelphia, an acquisition which proved of much importance during the war. Each subsidiary of the Taylor-Wharton Iron & Steel Co. retained its identity and Mr. Taylor was president of each.

During the war, in addition to the work of his company's own contracts, he helped supply railway track material for the American Expeditionary Forces, representing in the dealings with the Government all of the principal manufacturers of this class of product.

In 1903, Mr. Taylor was married to Lucy J. Miller, daughter of Llewellyn Miller of Baltimore, Md. Their children are Robert Knox Taylor, aged twelve, and Mary Summers Taylor, aged nine.

KNOX TAYLOR.

Mr. Taylor always kept up his keen interest in college affairs. In 1918 he was elected a life trustee of Princeton University; for many years he had been a member of the Board of Athletic Control and at the time of his death was chairman of the Football Advisory Committee.

He was deeply interested in all civic improvements. Foster M. Voorhees, in the *High Bridge Gazette* of April 6, says

> Every movement that tended to the betterment of the community and every agency already organized for that purpose had his cheerful and generous support. He aided and encouraged the many efforts put forth to make our community a better place in which we and those who follow us may live.
>
> A man whose aims were high, whose life was exemplary and whose character was noble, . . . our community is better for the life Knox Taylor lived.

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He was responsible for the organization of the first Boy Scout troop in the town, in 1914. As interest developed he provided equipment and space in the community center under the direction of the Y. M. C. A. and helped to establish the camps at Lake Solitude. In the second year the camp was named for Mr. Taylor by unanimous vote of the boys. Later a girls' camp was added. Mr. Taylor was instrumental in placing at the disposal of the community the present site of Camp Taylor for use over an indeterminate term of years.

During the war Mr. Taylor was keenly interested in the conservation and development of the food supply and encouraged its production by the formation of the Farmers' Club and the allotment of company ground so that men and boys of the town could have a chance to raise their own farm produce.

Mr. Taylor was a member of the American Institute of Mining and Metallurgical Engineers, which he joined in 1897, and also of many other societies and clubs, including the Railway Business Assn., of which he was vice-president, Down Town Assn., Rocky Mountain Club, American Society for Testing Materials, American Chemical Society, American Society of Mechanical Engineers, Society for Promotion of Engineering Education, Princeton Engineering Association, and the Iron and Steel Institute of England.

## Harry Firmstone

HARRY FIRMSTONE, president of the Longdale Iron Co., of Longdale, Va., died in Philadelphia on March 10, in the 74th year of his age. He was unmarried, and had no close relatives.

Mr. Firmstone's father, William Firmstone, was one of the pioneers in the anthracite iron business; he was manager of the Glendon Iron Works at Easton, Pa. when his son Harry was born in 1849. In 1870, William Firmstone, with Ario Pardee, organized the Longdale Iron Co., and in 1873, Harry Firmstone, after his father's death, became general manager of the company. Harry Firmstone was educated at the Polytechnic Institute of Philadelphia, and had worked under his father and older brother, Frank, at the Glendon Works.

A local newspaper says:

> Not a Rockbridge man, his home on the border of another county, a Northern man by birth and rearing, Mr. Firmstone identified himself in the affections and esteem of the people in western Rockbridge in a way that few living outside the county have ever done.
>
> The institution of which Firmstone was the head had by its fairness and generosity and uniform kindness and consideration with all with whom it had dealt, earned and received an appreciation which has not been forgotten and will not be for a long time by the people of western Rockbridge.

*The Iron Age* prints the tribute of a Philadelphia iron merchant in which he says: "No man in the iron business was more scrupulous than Harry Firmstone in living up to his contracts and agreements."

## Reuben L. Lindstrom

REUBEN LEONARD LINDSTROM, who died at Montreal on Dec. 12, 1921, was born in Moline, Ill., Nov. 26, 1889. He was graduated from the University of Illinois, School of Pharmacy, in 1911, with high honors, receiving a prize for having the highest standing in chemistry. Later, he achieved much success as a commercial chemist.

In 1917, he moved to Montreal and became metallurgist for the various plants of the Canadian Car and Foundry Co. In July, 1919, he became superintendent of the steel foundry. His personality made him popular with employees and friends.

He leaves his wife and three small children.

## George J. Salmon

GEORGE J. SALMON, a mining engineer connected with the U. S. Bureau of Mines, died on March 1, 1922, at his home in Philadelphia. He was a graduate of the Pennsylvania State College and a member of the Rocky Mountain Coal Mining Institute as well as of the American Institute of Mining and Metallurgical Engineers.

At the time of his death Mr. Salmon was engaged in work pertaining to the leasing of Government coal land. Prior to this he had served as an engineer for the War Minerals Relief Commission. He had also seen service with the Copper Range Co. at Painesdale, Mich. and with various other companies in different parts of the country.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Mar. 20, to Apr. 19, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1876 | Akerman, Richard | 1922 |
| 1880 | Almy, William F. | |
| 1917 | Argall, P. H. | March 19, 1922 |
| 1912 | Best, William Newton | April 11, 1922 |
| 1905 | Bostwick, William A. | Feb. 4, 1922 |
| 1920 | Eastick, Thomas H. A. | March 7, 1922 |
| 1879 | Firmstone, H. | March 10, 1922 |
| 1915 | Johnston, Francis B. | Dec. 8, 1921 |
| 1891 | McClure, Samuel | March 25, 1922 |
| 1916 | McRae, A. L. | |
| 1905 | Polkinghorne, John | Nov. 1921 |
| 1887 | Richmond, William H. | March 14, 1922 |
| 1891 | Sjogren, Hjalmar | March 23, 1922 |
| 1897 | Taylor, Knox | April 4, 1922 |
| 1887 | Varden, Richard A. | |

## Chemists to Meet in France

THE third international chemical conference will be held in Lyons from June 27 to July 2, under the auspices of the National Federation of Chemical Association of France. The last excursion taken by those in attendance will take them near to Marseilles, where the second congress on industrial chemistry will be held from July 2–7.

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# Institute Affairs

## A Democratic Institute

EVERY once in a while there comes a letter from a member scolding the directors for the undemocratic manner in which the affairs of the Institute are conducted.

Some years ago the Institute had grown to such a size and had undertaken to concern itself with so many special activities and branches of the profession that it became evident that better work could be done by distributing responsibility, and the directors more and more began to assume these responsibilities until now they carry on much of the serious work of the Institute.

The directors do not need scolding for operating on undemocratic lines; they know full well the desire of the members for a democracy and know that it is based on excellent reasons; they know that the future of the Institute depends on successful expansion in this direction and are constantly working toward that end.

The difficulty, then, is not one of convincing a "small coterie" in New York that they should give to those outside of this city a greater voice in Institute affairs and give the local sections more work to do, but it lies in the physical difficulty of getting the distant voice to express itself and of getting the sections to share in the work.

Wireless, the telegraph, or the mails do not take the place of the physical presence of the directors when a subject comes up for discussion, and though the distant director may vote on questions referred to the Board, it is impossible for him to have the benefit of discussions and familiarize himself with all phases of a question. Many questions demand immediate consideration and reply, precluding even the opportunity to hear from the distant member of the Board.

There are 24 members on the Board. During the year 1921, eight (one-third) of the members of the Board resided west of the Mississippi, in which territory resides about 38 per cent. of our membership. Geographically and numerically, the Board was, in its makeup, fairly representative of the membership, as much so as could be accomplished by any plan of election which has been suggested.

Unfortunately, election to the Board does not mean a corresponding participation in its work. Only rarely have the Central West members been able to attend a Board meeting, and the members from the Pacific Coast have come to meetings even less frequently.

During the year 1921, the 16 members of the Board from east of the Mississippi answered present on an average of six times, while the eight members from the West answered an average of less than once. The Eastern 62 per cent. of the membership had, during the year, representation at the Board meetings, as compared with the 38 per cent. Western membership, in the proportion of 96 to 6.

This is the unfortunate situation respecting which these several writers complain. It is not the undemocratic system of electing directors, but the fact that when elected the directors do not attend meetings. No one regrets this more than the "little coterie" in New York, who would most willingly throw work and responsibility upon the absent members.

If the critics of the present plan of elections would suggest some better plan, it would receive most respectful consideration, but constructive suggestions have not been forthcoming. The selection of directors is now and has been for years very largely in the hands of the members of those districts from which a director is to be appointed.

### Qualifications for a Director

The chairmen of the Nominating Committees of the last few years have used every effort to ascertain the desire of the members, no name has been put on the ballot without extended correspondence.

Unfortunately the members of some districts have not been always mindful of one most important qualification among those that a director should possess; namely, his ability to attend meetings. This is really of far more importance than that he be a distinguished member of his profession whose activities keep him at home during the greater part of the year.

There are many distinguished members with homes in the West, whose business frequently calls them to the East; there are some who, while their business interests are in the West, have found it necessary to take up temporary or permanent residence in the East. Such men are perfectly capable of representing Western thought and among them are to be found excellent material for the Board.

Bearing in mind, then, not only a theoretical, but a practical democracy, it is urged that our Western members bear this suggestion in mind when next it is their privilege and duty to select representatives.

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It may not be amiss to remind our members that in the early days the headquarters of the Institute were in the city where the secretary hung up his hat. The headquarters were frequently moved to all parts of the United States, but as the Institute grew it was found that some permanent home must be selected. A large donation was offered for a home in New York, but, before acceptance, the question was put to the vote of all members and the decision was unanimously in favor of a New York home. That has been decided once for all; whether the decision was wise or not is beside the question, but having been made, we must conduct our work as best we can in conformity with it. Suggestions looking toward improvement of the conduct of affairs are always welcomed and considered by the Board in the spirit in which they are offered.

There is one factor in the proper selection of directors that must be given serious weight. Nearly 30 per cent. of our members are primarily interested in metal mining, while the remaining 70 per cent. are primarily interested in one or the other of nine other branches of the mining industry. From this, it is evident that it would be very easy to name a directorate consisting almost or entirely of those whose primary interest is metal mining, while the other interests would be without adequate representation on the Board. In the past and with the system of nominations now in force, iron and steel, petroleum, coal and coke, geology, and other associated industries have been adequately represented on the Board. Any new plan of nominations must take into consideration the fact that democracy should apply to industry as well as to geography.

F. F. SHARPLESS.

## Summary of Directors' Minutes

AT THE meeting of the Board of Directors on March 24, 1922, there were present 10 directors, the secretary and assistant secretary, and 21 guests.

The committee appointed to consider the advisability of the participation of the Institute in an International Congress to be held in Philadelphia, in connection with the World's Fair in 1926, recommended that the Institute join with the other engineers in support of such a Congress; a committee was named to coöperate with similar committees from the other Founder Societies with this object in view.

The report of the treasurer and Finance Committee was presented and ordered filed.

There were elected 24 Members, 5 Associates and 33 Junior Associates; change of status, two from Associate to Member, two from Junior Associate to Associate; two members were reinstated; the name of Vincent Ferguson was added to the honor roll of senior members.

The By-Laws of the Southern West Virginia and the Northern Arizona Sections were approved.

Philip W. Henry, one of the representatives of the Institute on the Joint Committee on Code of Ethics for Engineers, read the report of that committee and the recommendations for putting such a code into effect. The substance of the proposed code brought forth discussion, as well as the procedure recommended by the committee, and two resolutions were passed: One, calling the code to the attention of members and asking them to give it consideration and advise the secretary in respect to any suggestions they might care to offer; the second calling for advice of counsel as to the legality of the proposed procedure.

An invitation was extended to the Mining Section of National Safety Council to hold a joint session at the 127th Meeting of the Institute in February, 1923.

The secretary reported the result of the postal card referendum as to relative interests in the classified subjects. Owing to the fact that returns on this referendum are still coming in, a final report cannot be rendered for some weeks. Publication will be made in MINING AND METALLURGY, so that all may be advised of the interests of their fellow members in the activities of the Institute. In the meantime, the classification is proving of great benefit to the directors and the officers of the Institute.

At the time of the February meeting, the City of Vancouver and the British Columbia Chamber of Mines extended an invitation to the Institute to hold its regular fall meeting in the City of Vancouver. Under instructions from the Board, the secretary made a preliminary canvass throughout the various local sections to learn what the sentiment would be toward holding a meeting in Vancouver. As a result of the canvass, the Board felt that it would be inexpedient to hold the fall meeting in Vancouver this year, and therefore instructed the secretary to regretfully decline the invitation.

The Executive Committee was empowered to select a place for holding the fall meeting of the Institute.

President Dwight announced the appointment of Messrs. George Otis Smith, H. Foster Bain, J. Edward Spurr, Pope Yeatman and the president ex officio, as a Committee on Industrial Preparedness, to coöperate with the War Department.

The matter of appointing a Committee on Education was referred to the Executive Committee with power.

The Committee on the Columbia Scholarship reported that the Woman's Auxiliary had selected Carleton B. Jansen, of Union College, Schenectady, as the beneficiary.

It was voted that the Board of Directors of the A. I. M. E. should request the American Engineering Standards Committee to designate the Institute as sponsor for the subject of Milling Standardization, experimental work upon which is now being conducted by the Committee on Milling Methods under the chairmanship of Dr. Galen H. Clevenger.

The Geological Club of Harvard University was admitted as an Affiliated Student Society.

A unanimous vote of thanks was extended to James

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T. Grady and the Federated American Engineering Societies for the efficient manner in which the proceedings of the last annual meeting were brought to the attention of the public.

The appointments of chairmen of various technical committees was approved.

The Committee on Petroleum and Gas presented a petition to form a separate Division of the Institute in accordance with Article XVII of the By-Laws, and the following resolution was unanimously adopted:

RESOLVED, that the formation of a Division of Petroleum Technology be authorized in accordance with the By-Laws providing for the organization of Divisions.

The president appointed the present Committee on Petroleum and Gas as a committee to put this resolution into effect.

The following resolutions were unanimously adopted:

BE IT RESOLVED:

That the American Institute of Mining and Metallurgical Engineers found a bronze medal in memory of Captain Anthony F. Lucas.

That a perpetual fund adequate for this purpose be raised by popular subscription, which will be conserved and administered by the Institute.

That the medal be granted on suitable occasions for noteworthy future contributions to knowledge of oil or gas fields, or to the technology of producing oil and gas.

That the Institute be authorized to accept subscriptions for this purpose.

That the officers of the Institute be authorized to plan the best method of administering the fund and of selecting worthy recipients of the medal.

The new Petroleum Division has guaranteed to raise the required fund.

## Papers for Fall Meeting

MANUSCRIPTS of papers to be presented at the Fall Meeting of the Institute, 1922, must reach the Secretary's Office by July 1. If a paper is to be submitted through a technical committee, it should reach the chairman of that committee early enough so that he can transmit it to the Institute by the date named.

# Local Sections and Affiliations

## Local Section Convention

LOCAL sections of the Institute are a conception of rather recent date, but the seed having once taken root the growth of the idea has been rapid, and there are now 26 full-fledged sections. The first convention of these sections was called on the occasion of the annual meeting of the Institute in February last. Sixteen sections were represented by their officers or appointed delegates, and round-table conference was held on subjects that these representatives chose to bring forward.

President Dwight, who presided, opened the discussion by referring to a subject to which the directors have given much study, that is, the union of engineering societies for work of common interest. Philip N. Moore, of the St. Louis Section, said, "Your presence here marks a distinct step in a desirable object, namely, the gradual decentralization of the Institute, the turning of its councils into the hands of those who can not be here constantly."

L. W. Wallace, secretary of the Federated American Engineering Societies, told of the work that it is doing in the way of educating the public to a realization of what engineers were doing and could do toward the advancement of industry and public welfare.

The Employment Bureau, in which the Institute is an active participant, was described by Mr. Swartout, who told of the methods employed in New York for securing the attention of employers and of how these might be copied to advantage by the local sections.

President Dwight spoke of the relation of the local sections to the Institute, the need of retaining the active interest of local members, and the need of searching for men suitable for membership in the Institute and thereby strengthening the local sections.

W. E. McCourt, of the St. Louis Section, told how that section is coöperating with the Federated and how it is conducting its own small employment bureau, then, passing on to local activities, explained how the section is participating not only in matters of engineering interest but also in civic and state affairs. Two general and rather largely attended meetings are held by the section every year, with monthly meetings of less pretention in the intervals. He asked that some arrangement be developed whereby local secretaries may be kept advised of all new members and changes of address in the various districts and said, "We feel that our group exists, among other reasons, for the purpose of bringing the mining engineers into closer contact, especially bringing the younger men into contact with the older men. I spend much time at this. We have been very successful and it pays. A man feels that he has a home when he comes to our district, and that makes him a good and contented member."

Horace F. Lunt, of the Colorado Section, spoke

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particularly on the close coöperation between the Denver members and the Junior Associates at the School of Mines at Golden. Members from Denver make a point of going to the monthly meetings at Golden, while the boys are encouraged to attend the meetings of the section at Denver. The members of the latter section feel that this plan is of great benefit to both the older and younger members of the Institute. Mr. McCourt said that the St. Louis Section members follow much the same practice with the students of the mining school near that city.

William Kelly, of Vulcan, Mich., had several constructive suggestions and said in part:

I conceive that the purpose of this meeting is to discuss the manner in which the local section may assist in bringing the individual member closer to the Institute. The local section centering in a city may easily gather to its meetings quite a number of members, but the time required and the expense incurred when the section covers a wide area make large meetings almost prohibitive, unless something of particular interest draws them together.

I have thought that we might secure a more direct connection between the sections and the Institute if it were possible to arrange to have the directors more representative of the sections. Just what improvements may be made in this direction, I do not know, but it is something worth thinking about.

We have recently had placed before us by the directors the matter of the registration of engineers. This is a matter of complying with state laws and if the mining engineers are going to do anything it will have to be done through local sections.

It is a political question, but one in which all engineers are interested, and if taken up by the sections I feel that it may be a means of uniting the sections a little more closely and at the same time hold us closer to the Institute.

Mr. Dwight explained to the members that this was one of the subjects he had on his list, for he, too, felt that it was one of great importance to mining engineers. The opinion among mining engineers being almost unanimous, the members of each section could strongly oppose legislation in this direction, knowing that they would have all the backing that the Institute could possibly give.

Charles B. Murray, secretary of the Ohio Section, said that in Cleveland they have been trying to have meetings every month, but he thought that perhaps this was too often. Mr. Murray felt that section members should not be called upon for any local dues and thought that the fact of their being asked to contribute to local expenses militated against large local attendance and reflected adversely on the interest of local members in the Institute. The death of the licensing bill in Ohio was largely due to the work of the local section at the last meeting of the Legislature and he promised that it would be opposed with equal force when it comes up again.

E. D. Gardner, of San Francisco, said that their section now includes nearly all eligible members of the Institute and that it is a very live section.

L. K. Armstrong, of the Columbia Section, said that they regard every man within their territory as a member of the local section and treat him as such until he becomes one in fact. Mr Armstrong continued:

We have two mining schools near us, one at Washington, the other at the University of Idaho. Our local engineers often visit these schools and we are well repaid, getting youth for ourselves while giving them of our experience.

Washington possesses great resources both in metallic and non-metallic wealth. During one of our four annual meetings we take a trip through one of the mining districts, meeting the men and getting acquainted with the industry.

In Spokane we have a club of the members of the four Founder Societies and once a week we have a dinner, the average attendance being about 40. The only difficulty with these meetings is that they are so interesting that no one ever wants to go home. This club has ventured into local politics and has been successful in securing the employment of engineering talent for our civic improvements.

We have found that the Institute spirit of exchanging information has been growing rapidly in our district. Only a few years ago it was customary for the operators in the Coeur d'Alene district to keep their work and their expenses to themselves. A most decided change has come about. Since 1915, almost every plant has been as wide open as earlier it was firmly closed. The Institute's spirit has accomplished splendid results both for the operators and the engineers of our country.

One of the most important things is to maintain friendly relations with headquarters; not always harmony perhaps, for we cannot always see eye to eye. If we are not getting what we want we go after it or learn why we cannot have it.

Arthur Thacher, of St. Louis, said, "We had, in Missouri, the same experience as Mr. Armstrong mentioned in the Coeur d'Alene. For 20 years or more after our lead mines were opened their shafts were closed to visitors. Largely through Mr. Moore, the Institute, and the St. Louis members, the reticence to publicity has been overcome and a mining engineer now goes where he lists through the mines and plants."

Mr. Dwight then took up the subject of licensing engineers, telling the members of the convention that it had come upon the mining engineers with rather startling rapidity. He told of the study given to the subject by the American Engineering Council and its attempt to draw up a model law that could be supported by all engineers. When the model law finally came before that body for adoption, opinion proved it to be about equally divided and a new attempt is now being made.

In sending out its resolution to local sections, it was not the intent of the directors to guide them in the course that they should pursue but rather to advise them that if they wish to exert their influence against the licensing of mining engineers they may know that they have the backing of a great majority of the members of the Institute.

W. Spencer Hutchinson, of Boston, spoke at length of the desire of the Boston Section to join with the Affiliated Technical Societies of Boston and asked for suggestions as to how they might secure the necessary financial assistance that such affiliation would require.

In bringing the meeting to a close, Mr. Dwight said, "I would like to take this opportunity of saying that I think this meeting has been productive of a great deal of good. It has brought into contact all parts of the country. It has been most enlightening and helpful to your new officers, who will be able to feel that they are in closer touch with the sections, and that means with the membership. We will certainly strive to carry on the good work, and serve you as efficiently and as effectively as possible."

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## Annual Meeting of Montana Section

THE ninth annual meeting of the Montana Section was held at the Silver Bow Club, in Butte, on the evening of March 18. Theodore Simons, past chairman, presided, and 39 members and guests were present.

John L. Boardman read a paper on Economic Aspects of Safety First, and Rene Engel presented one on Reclamation of Exhausted Oil Fields. Brief addresses were made by Albert Burch, chairman of the San Francisco Section; W. B. Daly, member of the Montana Section; and William H. Bassett, of the American Brass Co., Waterbury, Conn.

Officers for the ensuing year were elected as follows: chairman, W. B. Daly; vice-chairman, L. V. Bender; secretary-treasurer, E. B. Young; members of executive committee, E. M. Norris and George T. McGee.

Five meetings of the Montana Section were held during 1921.

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## Fuel Problems and Mining Policy

THE 73rd meeting of the Boston Section was held on Monday evening Feb. 6, 1922. After a dinner, which was well attended, the business meeting was called to order by Chairman W. Spencer Hutchinson, with 53 members and guests present.

By request, Charles T. Main, one of the guests gave a brief account of the efforts of the combined engineering committee last year in defeating the Engineers License Bill in Massachusetts, and called attention to the effectiveness of combined effort in matters of that kind. H. Foster Bain, director of the Bureau of Mines, was the speaker of the evening. He addressed the meeting on the Fuel Problems of New England. Mr. Bain introduced the subject by saying that in ancient times the nation or individual that owned and obtained the results of the labors of the greatest number of slaves was wealthiest but that today the fuel consumption is in a general way the best index of industrial activities. In other words, the community with the greatest number of tons of coal working for it is likely to be the one of greatest industrial importance.

Some interesting figures were given showing the fuel consumption per capita in different parts of the country, and for different periods during modern times. Mr. Bain discussed the different forms of fuel available and in use here and the geographical distribution and reserves of each. He brought out the fact that the supply of anthracite is definitely limited, and that therefore the production is not apt to increase greatly, nor the costs of mining to be materially reduced.

He pointed out also that the bituminous coal and oil resources are very large in extent, and the production is likely to increase. These have the advantage of being closer to the Atlantic seaboard, and will therefore benefit from the anticipated reductions in marine freight rates.

Mr. Bain expressed the opinion that the use of soft coal and oil would probably increase much more rapidly in New England than that of anthracite, and that the latter would probably ultimately be used only for domestic purposes.

Mr. Bain called attention to the fact that the high cost of transporting anthracite by rail is due to the immense amount of railroad equipment required, the investment on which probably exceeds the investment in equipment at the mines, and also discussed the proposal which has frequently been made to generate electric power at the mines and transmit it long distances instead of hauling the coal; he believes that little could be gained in this way, on account of the high investment cost of transmission lines.

Regarding the possibilities of hydro-electric development in New England, Mr. Bain said that, while no doubt important, they do not form a large factor, as surveys have shown that if all the hydro-electric power in New England were developed it would not greatly reduce the coal consumption.

Upon the conclusion of his talk, Mr. Bain showed a very interesting film prepared under the supervision of the Bureau of Mines, illustrating the manufacture of carborundum and other abrasive products at the plant of the Carborundum Co. in Niagara Falls.

The 74th meeting of the section was held on March 6, with 26 members and guests present. In the absence of the chairman, the meeting was called to order by Vice-chairman F. W. Paine.

At the close of the business session, Mr. Paine announced that the remainder of the meeting would be a joint technical session with the Mining and Metallurgical Society, with Allen H. Rogers, president of that society, presiding. Mr. Rogers took the chair and introduced Van H. Manning, director of the American Petroleum Institute, who was scheduled to speak on Foreign and Domestic Mining Policy.

Mr. Manning commented on the lack of a definite mining policy, especially foreign, which had characterized our Government in the past, and described the steps leading to the appointment of a committee of the Mining and Metallurgical Society to study the matter. He read the report of this committee and discussed it at considerable length, the gist of the report and his remarks being that inasmuch as the natural distribution of minerals does not conform to national boundaries, it is essential for the good of the world in general that they be moved freely from one country to another without undue tariff restrictions and that their development be permitted to anyone needing them, so far as possible without restriction as to nationality. Considerable discussion followed.

Officers for the year were elected as follows: chairman, W. Spencer Hutchinson; vice-chairman, H. A. Wentworth; secretary-treasurer, Roy B. Earling; members of executive committee, F. A. Eustis, Daniel Cushing.

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## St. Louis Section Annual Meeting

THE ninth annual dinner and meeting of the St. Louis Section was held on April 1, 1922, with 54 members and guests in attendance. F. W. DeWolf presided. At the close of the dinner, the secretary reviewed the activities of the section during the past year, noting, among other things, that five meetings have been held since the last annual meeting. At the fifth one, held on March 1, Eugene McAuliffe gave a paper on the bituminous coal situation.

At the annual meeting, Colonel Dwight, president of the Institute, addressed the section on the subject of Institute activities and policies. W. E. Rolfe, vice-president of the Federated American Engineering Societies, spoke on the work of that organization, and R. G. Hall gave an illustrated talk on some of his experiences during a stay of several years in Burma.

The following were elected officers of the St Louis Section for the current year: chairman, B. O. Mahaffey, vice-chairmen, A. W. Dickinson, Charles T. Orr, C. G. Dresser; secretary-treasurer, W. E. McCourt; members of executive committee, A. H. Cronk, I. F. Hodges, J. D. Robertson, L. E. Young; F. W. DeWolf, retiring chairman.

## Metric System Discussed by Colorado Section

A MEETING of the Colorado Section was held following a 6:30 dinner at the Albany Hotel, Denver, on March 24, 1922. Chairman Hursh presided, and 62 members and guests were present. Popular songs, led by W. H. Bullock, were sung between courses.

Mr. Farish, chairman of the committee appointed to consider the revision of the mining laws, reported that the committee, consisting of himself, James Underhill and Russell Paul, had decided that the question had been fully covered by the Colorado Metal Mining Association and the American Mining Congress and that any definite report from the Colorado Section of the Institute would simply be a duplication. This report was accepted.

The committee appointed to consider the adoption of the metric system, consisting of R. J. Grant, chairman, H. B. Lowden and Herbert Addison, reported, on the basis of the questionnaire of the Mining and Metallurgical Society of America, that while the general introduction of the metric system might constitute an advance in efficiency, a general change would be accompanied by vast confusion. If adopted, the change should be left entirely to individual initiation; not be assisted by resolutions of technical and business organizations; and that the Federal Government should not take any further steps in the matter, except possibly in coöperation with Great Britain. This report was adopted.

R. I. Meeker, special deputy state engineer, gave an interesting account of the interstate controversy concerning the waters of the Colorado River, and F. W. Whiteside, chief engineer of the Victor-American Fuel Co. and president of the Rocky Mountain Coal Mining Institute, made an address on Coal, illustrated by lantern slides showing the mining and handling of coal. George Watkin Evans, a prominent coal mining engineer of Seattle, made a brief speech, and George J. Bancroft gave an account of some of the early projects for transporting water from the Colorado River basin to other watersheds.

## Mining in Mexico

THERE was a specially called meeting of the Columbia Section at the Davenport Hotel, Spokane, on March 16, to hear a lecture by Dr. Henry Mace Payne on Mining in Mexico. The meeting was preceded by a dinner party, at which 24 members, ladies and guests, were present. About 200 persons were present for the lecture.

Doctor Payne said that Americans should take a lively interest in the Mexican situation, because, with the defection of Russia and the turmoil in Europe, American investment may very logically be directed toward Mexico.

The present government is building many schools and establishing training schools for teachers. Automobile roads are being built and the railroad lines are being rapidly rehabilitated. Mining is being actively resumed in silver and the higher grade properties in lead, zinc, copper and gold are beginning to receive attention. Interest is centered in silver, however, because of the proposed subsidy on silver mining in Mexico, which would place silver there on a par with the Pitmann Act in the United States.

Doctor Payne showed lantern slides, depicting scenes of domestic, rural, city and mining activity.

## Affiliated Student Societies

**Harvard University.**—The Geological Club has been accepted as an affiliated student society of the American Institute of Mining and Metallurgical Engineers. The purpose of the club is to further the study of geology and geography at Harvard University. There are 41 active members, including graduate and undergraduate students. The officers are: James A. Noble, president; S. C. Spindel, vice-president; Gordon Gunther, secretary; R. M. Burke, treasurer; T. H. Clark, graduate representative.

**Lafayette College.**—At a meeting of the John Markle Mining Society, held in South College on March 31, Prof. D. A. Hatch delivered an address on the Present Coal-mining Situation. He told about the steady growth of the United Mine Workers' Union and gave a brief history of past strikes. He gave the demands of the miners in the present strike and some of the opinions of the public and operators.

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# Correspondence and Discussion

## Northwest Mining Association on Revision

ENCLOSED herewith you will find copy of resolution adopted by the Northwest Mining Convention, in twenty-seventh annual assembly during the week of Feb. 14–18, 1922.

We commend the same to your earnest consideration.

Northwest Mining Association,
G. B. DENNIS,
*President.*

SPOKANE, WASH., Feb 7, 1922.

RESOLUTION No. 12, REVISION OF MINING LAWS

WHEREAS, there is now before Congress a bill providing for revision of the mining laws for the alleged benefit of the prospector and operator of the West, and,

WHEREAS, that measure has already been opposed by the Northwest Mining Association in a resolution and able brief, prepared by Mr. Frank A. Ross, former president of that association.

NOW, THEREFORE, BE IT RESOLVED, by the Northwest Mining Convention in 27th annual assembly, this, the 17th day of February, 1922, that it endorses every word in such resolution and brief as prepared by Mr. Ross, and adopts them both *in toto* as the expression of this convention.

AND, BE IT FURTHER RESOLVED, that, in answer to criticism of the Northwest Mining Association, in a certain eastern publication, alleging that the association has, in part, reversed itself upon the matter of revision of the mining laws, this convention cheerfully admits such reversal of opinion, in part, and further declares that the mining industry of the West is tired of regulation and restriction and prefers, for the present, to work its way back to prosperity through the aid of laws which are now well understood, even though imperfect, rather than fly to evils of which it can have no knowledge short of actual operation.

AND, BE IT FURTHER RESOLVED, that this Convention extends its sincere thanks to the Northwest Mining Association for so clearly expressing its views upon this question and promises it undivided support in any further opposition to such measures that it may decide necessary.

AND, BE IT FURTHER RESOLVED, that copies of this resolution be sent to the Editor, MINING AND METALLURGY, and members of congressional delegations from Oregon, Washington, Idaho, and Montana.

SIDNEY NORMAN,
*Chairman Resolutions Committee.*

# Government Action of Interest to Engineers

## Extracts from Weekly Bulletin Issued by American Engineering Council

APRIL 14, 1922

**Trade Associations Conference.**—At a Trade Associations Conference held at the Department of Commerce on April 12, representatives of a large number of trade associations expressed their views as to proper activities which such organizations might conduct. Mr. Hoover pointed out the great progress that has been made as a result of plans to use the coöperation of technical and commercial organizations, but he emphasized especially the fact that he did not in any case desire to make such coöperation compulsory.

**Trade Associations to be Investigated and Defined.**—The Senate Commerce Committee has favorably reported a bill creating a Joint Congressional Committee to investigate and prepare legislation defining trade associations and their rights under the law. This bill failed to pass by unanimous consent April 12, but will be further pushed.

**Hydroelectric Power Projects Discussed by Cabinet.**—The Boston to Washington super-power survey, the Colorado River development and other projects were discussed by President Harding and his Cabinet on April 8, as a means of minimizing the effect of coal strikes in the future and also in relation to the general economic fabric of the country.

**Muscle Shoals Proposition.**—The chairman of the Senate Agricultural Commission will shortly propose a resolution for a government owned and operated

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corporation for the development of the nitrate and water power projects at Muscle Shoals.

APRIL 7, 1922

**Patent Law, Working Clause Amendment.**—The Senate Committee on Patents held a hearing April 6 on S. 3325 which proposes to amend the patent laws so that every patent granted by the Government will have to be worked or become invalid. The Patents Committee of the American Engineering Council submitted a statement to the Senate Committee opposing a favorable report on this bill.

**Highway Legislation.**—The Committee on Roads of the House of Representatives on April 6 reported out a highway bill appropriating $65,000,000 for Federal aid during the next fiscal year and $75,000,000 for the fiscal year ending June 30, 1924.

MARCH 30, 1922

**Alaska Coal Mines.**—The Department of the Interior has taken over the work heretofore done by the Navy Department in developing coal mines in Alaska. The Secretary of the Interior has announced that Director Bain of the Bureau of Mines will go to Alaska to formulate plans for proving the extent and value of Alaskan coal mines.

## Large High-tension Electrical Transmission Systems

A COMPLETE report of the papers presented at the international conference organized by the Union des Syndicats de l'Électricité, and held in Paris, Nov. 21–26, 1921, is being prepared, and will be published in both French and English. The object of the conference was the study of technical questions relating to the construction and operation of long transmission lines operating at very high tensions.

The Union des Syndicats de l'Électricité asks those who wish this report to send word as soon as possible regarding the number of copies desired, stating which edition will be wanted, French or English. Until May 15, 1922, the price will be 60 fr. per volume; after that date, it will be about 75 fr. per volume, but cannot be fixed definitely until the number of copies to be printed has been decided. Address M. Tribot-Laspière, Secrétaire Général de l'Union des Syndicats de l'Électricité, 25 Boulevard Malesherbes, Paris, France.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Amer. Zinc Inst. | St. Louis, Mo. | May 8–9 |
| Amer. Soc. Mech. Engrs. | Atlanta, Ga. | May 8–11 |
| Foreign Trade Convention | Philadelphia, Pa. | May 10–12 |
| Amer. Foundrymen's Assn. | Rochester, N. Y. | June 5–9 |
| Inst. of Metals Div. A. I. M. E. | Rochester, N. Y. | June 5–9 |
| Soc. Automotive Engrs. | White Sulphur Spr., W. Va. | June 20–24 |
| Amer. Assn. for Adv. of Sci. | Salt Lake City, Utah | June 22–24 |
| Amer. Soc. for Test. Mats. | Atlantic City, N. J. | June 26–July 1 |
| International Chemical Conference | Lyons, France | June 27–July 2 |
| Assn. des Ingénieurs sortis de l'Ecole de Liége | Liége, Belgium | June 11–16 |
| Congress on Industrial Chemistry | Marseilles, France | July 2–7 |
| 13th Intl. Geol. Congress | Brussels, Belgium | Aug. 10–19 |

# Increase of Membership Department

**Total membership as of April 15, 1922, is 10,152**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period March 20, to April 19, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

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## Candidates for Membership

### Members

**1—Alfred Paul Frey,** Cartagena, Colombia, S. A.
Present position—1921 to date: Geologist, Bataafsche Petroleum Maaschappij, Cartagena.
Proposers: W. H. Whittier, W. Van Holst Pellekan, George A. Macready.

**2—Julian Stuart Gravely,** New Haven, Conn.
Present position—1920 to date: Engineering Superintendent, Winchester Repeating Arms Co.
Proposers: William B. Price, W. M. Corse, Paul D. Merica.

**3—Robert Keffer,** Anaconda, Mont.
Present position—1919 to date: Research Chemist, Anaconda Copper Mining Co.
Proposers: Louis V. Bender, Frederick F. Frick, Harry S. Ware.

**4—Karl Hartness Marsh,** Sydney, Nova Scotia, Canada.
Present position—1920 to date: Chief Engineer, Dominion Iron and Steel Co. and Dominion Coal Co.
Proposers: Walter Herd, A. W. MacDonald, F. E. Lucas.

**5—Charles Harold Memory, Jr.,** South Orange, N. J.
Present position—1919 to date: Coal Mining Department, American Smelting and Refining Co.
Proposers: C. A. Baker, C. E. Meissner, H. A. Guess.

**6—James Isaac Moore, Jr.,** Britannia Beach, B. C., Canada.
Present position: Mine Superintendent, Britannia Mine.
Proposers: J. F. Kemp, Robert Peele, J. Pendleton Wood.

**7—Gus Lewis Rogers,** Homestead, Ore.
Present position: Secretary and General Manager, Panhandle Copper Co.
Proposers: Robert M. Betts, James A. Panting, Eugene Antz.

**8—Robert Pierce Sanborn,** East Orange, N. J.
Present position—1920 to date: Manager, Traction Department Edison Storage Battery Co.
Proposers: John T. Ryan, George H. Deike, Howard Eckfeldt, A. C. Callen, William H. Patton.

**9—Dale Raymond Snow,** Tulsa, Okla.
Present position—1920 to date: Chief Geologist, Waite Phillips, Oil and Gas Producer.
Proposers: H. B. Goodrich, M. M. Valerius, C. A. Cheney.

**10—William Nelson Watson,** Broken Hill, N. W. Rhodesia, Africa.
Present position—1921 to date: Research Chemist, Rhodesia Broken Hill Development Co.
Proposers: J. O. Betterton, Virgil T. Price, S. J. Splak.

**11—Arthur Sampson White,** Dowell, Jackson Co., Ill.
Present position—1921 to date: Mining Engineer, Union Colliery Company, St. Louis, Mo. (Mine at Dowell, Ill.)
Proposers: Eugene McAuliffe, Arthur Thacher, Philip N. Moore.

### Associates

**12—Nicholas Nikolaevitch Vishnevsky,** Washington, D. C.
Present position: U. S. Bureau of Mines, Salt Lake City, Utah.
Proposers: Robert Peele, R. M. Raymond, Edward F. Kern.

### Junior Associates

**13—E. Maurice Adams,** Moorhead, Minn.
Student, University of Minnesota.
Proposers: W. R. Appleby, Peter Christianson, Walter H. Parker.

**14—Harry John Bruner,** Boston, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

**15—Donald Barcher Campbell,** Corvallis, Ore.
Student, Oregon State College.
Proposers: J. H. Batcheller, Charles E. Newton, G. E. Stowell.

**16—Clarence Lewis Christiansen,** Portland, Ore.
Student, Oregon Agricultural College.
Proposers: James H. Batcheller, Charles E. Newton, G. E. Stowell.

**17—Gus Edward Danielson,** Cambridge, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

**18—Jerome Thomas Eckenrode,** Steelton, Pa.
Student, Pennsylvania State College.
Proposers: D. F. McFarland, A. M. Rodgers, William R Chedsey.

**19—John Carton Flaherty,** Boston, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

**20—Warren Roy Gettler,** Hannibal, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, T. M. Bains, Jr., M. H. Thornberry.

**21—Arnold A. Gustafson,** Duluth, Minn.
Student, University of Minnesota.
Proposers: W. R. Appleby, Peter Christianson, Walter H. Parker.

**22—Edwin James Heap,** Atlantic, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

**23—Lawrence Irving Hope,** Minneapolis, Minn.
Student, University of Minnesota.
Proposers: W. R. Appleby, Peter Christianson, Walter H. Parker.

**24—Elmer Lawrence Johansen,** Somerville, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Charles E. Locke, Carle R. Hayward, W. Lindgren.

**25—Fitzhugh Bayton Jones,** Golden, Colo.
Student, Colorado School of Mines.
Proposed by: R. J. Grant, James Underhill, J. C. Roberts.

**26—Dewey Bernard Larson,** Corvallis, Ore.
Student, Oregon School of Mines.
Proposers: Charles E. Newton, J. H. Batcheller, G. E. Stowell.

**27—Wade Vernon Lewis,** Corvallis, Ore.
Student, Oregon School of Mines.
Proposers: James H. Batcheller, Charles E. Newton, G. E. Stowell.

**28—Frank Cornelius Linton,** Corvallis, Ore.
Student, Oregon School of Mines.
Proposers: J. H. Batcheller, Charles E. Newton, G. E. Stowell.

**29—Curtis Gilliam Mohney,** Corvallis, Ore.
Student, Oregon School of Mines.
Proposers: James H. Batcheller, Charles E. Newton, G. E. Stowell.

**30—Paul Fisher Mumma,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Benjamin L. Miller, Howard Eckfeldt, G. A. Roush.

**31—Richard Charles Patten,** Minneapolis, Minn.
Student, University of Minnesota.
Proposers: W. H. Emmons, Clinton R. Stauffer, Walter H. Parker.

**32—Frank James Plut,** Grosby, Minn.
Student, Minnesota School of Mines.
Proposers: E. H. Comstock, Peter Christianson, Walter H. Parker.

**33—Darwin Jesse Pope,** New York, N. Y.
Student, Columbia University School of Mines.
Proposers: R. M. Raymond, Robert Peele, Arthur L. Walker.

**34—Palmer Cosslett Putnam,** Cambridge, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

**35—Horace Dwight Scruby,** Chillicothe, Mo.
Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**36—Alfred Richmond Smith,** Brooklyn, N. Y.
Student, Columbia School of Mines.
Proposers: R. M. Raymond, Robert Peele, Arthur L. Walker.

**37—William Wesly Staley,** Socorro, N. M.
Student, New Mexico State School of Mines.
Proposers: T. W. Quayle, W. G. Ramlow, E. H. Wells.

**38—Philip Morris Stearns,** Wakefield, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

**39—John Wadsworth William Sullivan,** Boston, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Edward E. Bugbee, Charles E. Locke, Carle R. Hayward.

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**40—Parker Davies Trask,** Oakland, Cal.
Student, University of California.
Proposers: Frank H. Probert, W. S. Morley, Lester C. Uren.

**41—Louis Harold Tucker,** Lawrence, Kans.
Student, University of Kansas.
Proposers: C. M. Young, R. S. Knappen, Sherwin V. Kelly.

**42—Robert T. Wood,** Palmerton, Pa.
Student, Lehigh University.
Proposers: Benjamin L. Miller, H. B. Pulsifer, G. A. Roush.

Change of Status—Associate to Member

**43—Burnham E. Field,** Long Island City, N. Y.
Present position—1921 to date: Metallurgical Engineer, Union Carbide and Carbon Research Laboratories, Inc.
Proposers: C. E. McQuigg, A. L. Meyer, F. M. Becket.

**44—Be Van Presley,** Latouche, Alaska.
Present position—1919 to date: Mill Foreman, Kennecott Copper Corpn.

**45—Curt Nicolaus Schuette,** San Francisco, Cal.
Present position: Unemployed.
Proposers: Frank H. Probert, Byron O. Pickard, L. H. Duschak.

**46—Earl Adam Trager,** Panuco, Ver., Mexico.
Present position—1921 to date: Chief of Sub-Surface Geology, Marland Oil Company of Mexico.
Proposers: Albert D. Brokaw, W. E. Wrather, George C. Matson.

Change of Status—Junior Associate to Member

**47—Joseph C. Barton,** Ashland, Ala.
Present position—1920 to date: General Manager and Treasurer, Griesemer Graphite Co.
Proposers: K. K. Hood, Rush M. Hess, H. A. Coy, Frank C. Hooper.

**48—Henry S. Burnholz,** New York, N. Y.
Present position: Teaching temporarily.
Proposers: R. M. Raymond, Frank J. Nagel.

**49—Thomas Fraser,** Urbana, Ill.
Present position—1919 to date: Assistant Mining Engineer, U. S. Bureau of Mines.
Proposers: J. J. Rutledge, H. H. Stoek, Ray W. Arms.

**50—Herbert Betts Wolcott,** El Paso, Tex.
Present position—Manufacturer's Agent.
Proposers: John I. Kane, W. N. Small, D. Cole.

Change of Status—Junior Associate to Associate

**51—Charles Winegar Crispell,** Bridgeport, Conn.
Present position—1919 to date: Process Engineer, Bridgeport Brass Co.
Proposers: Walter R. Clark, W. R. Webster, Carl F. Dietz.

**52—Maynard Mizel,** Brooklyn, N. Y.
Present position—1921 to date: Charge of Sales Department, Phinotas Chemical Co.
Proposers: Howard Eckfeldt, Benjamin L. Miller, G. A. Roush.

**53—Edward Tuttle Plumb,** Winchester, Ky.
Present position: Statistician.
Proposers: Luther W. Bahney, F. M. Towl.

**54—Thomas Graham Ralph,** Port Huron, Mich.
Present position—1920 to date: Plant Engineer, Athol Manufacturing Co., Marysville, Mich.
Proposers: Benjamin L. Miller, Howard Eckfeldt.

**55—Raymond Samuel Weimer,** Rock Springs, Wyo.
Present position—1920 to date: Resident Mine Engineer, Central Coal and Coke Co.
Proposers: Charles H. Fulton, H. A. Buehler.

## Do You Know Where These Men Are?

NAME — LAST ADDRESS OF RECORD FROM WHICH MAIL HAS BEEN RETURNED

AIKEN, CHARLES WILSON, Production Engr., Stromberg Motor Devices Co., Chicago, Ill.
AINSWORTH, ROBERT E.....General Delivery, Globe, Ariz.
APPLETON, JOHN R., Colorado School of Mines, Golden, Colo.
ARMSTRONG, CLIFTON T.....Pachuca, Hidalgo, Mexico.
BAIRD, DAVID BIRCH, Sigma Phi Epsilon House, State College, Pa.
BARCUS, WALTER J. E., Care Hotel Tivold, Panama Canal Zone.
BELL, FRANK R.....Bartlesville, Okla.
BLOCK, JAMES A., Resident Engr., Thacker Fuel Co., New Thacker, W. Va.
BLOW, JOHN J....404 High Holborn, London, W. C., England.
BRENNON, JOHN C....103 East 84th St., New York, N. Y.
BRADLEY, D. H., JR.....Box 93, Prescott, Ariz.
CARNS, FOSS D., Arizona Binghamton Copper Co., Stoddard, Ariz.
CHANG, KO CHI, Student, Carnegie Inst. of Tech., Pittsburgh, Pa.
CHU, S. Y.....Columbia Univ., New York, N. Y.
CLELAND, GEORGE A....Miazza Woods Bldg., Meriden, Miss.
CRANE, GUY WALTER, Chief Consolidated Min. Co., Eureka, Utah.
CROCKER, A. L., 601 North West Bank Bldg., Minneapolis, Minn.
DAVIES, R. G.....2524 Hilgard Ave., Berkeley, Cal.
DONDERO, F. NICHOLAS.....Box 636, Ruth, Nev.
FERNAU, J. J. C., Hertion Wharf Works, Alferton, Wombley, London, England.
FLETCHER, F. M.....Independence Min. Co., Phelan, Tex.
FRISBIE, HOWARD I.....Race Track, Mont.
GRANTING, HUGO G.....Box 966, Warren, Ariz.
GRAY, T. E., Student, Colorado School of Mines, Golden, Colo.
GREBE, EMIL.....Phoenix, Ariz.
GRUBB, EVERETT L.....620 N. Lake St., Madison, Wis.
HART, RAY W.....1112 E. 9th St., Tucson, Ariz.
HATFIELD, PERCY W., 3312 Woolworth Bldg., New York, N. Y.
HAYES, FREDERICK H., The Worthington Co., Inc., 510 Mills Bldg., El Paso, Tex.
HILL, BENJAMIN F.....302 N. 4th St., Cripple Creek, Colo.
HINDSHAW, H. H.....617 Forest Ave. Ann Arbor, Mich.
HOAAS, OLE G.....1644 Taylor St., San Francisco, Cal.
HOGNASON, GUY B.....Phoenix, Ariz.
HURD, HAROLD W., 400 W. Capitol Ave., Springfield, Ill.
KILDAL, HERMANN.....Cripple Creek, Colo.
LAWRENCE, WILLIS.....Mammoth Mines, Mesa, Ariz.
LI, CHU.....Student, Columbia Univ., New York, N. Y.
LIDVALL, EDWARD ROBERT, 159 Pierpont Ave., Salt Lake City, Utah.
LYONS, CLYDE FRANCIS.....Box 18, Tyrone, N. M.
MCDONALD, JOHN A., 322 Federal Bldg., Salt Lake City, Utah.
MCVEY, EARLE YANCEY, Genl. Supt., Mine Office, Coal Beth Coal Co., Bentree, W. Va.
MAILHOT, CHARLES, C. M. Fassett Co., 209 Wall St., Spokane, Wash.
MARCH, HARRY, Councillor, Midland Institute of Min. Engrs., 17 Victoria St., Westminster, London, S. W., England.
MARSH, LESTER C....1319 Van Horn Road, Independence, Mo.
MARSTON, ROBERT L.....Carter Oil Co., Tulsa, Okla.
MILLS, FRANK S.....Province Lake, N. H.
MORGAN, D. M.....407 W. 4th St., Joplin, Mo.
NICHOLSON, FRANCIS....Laurill, Charlotte Court House, Va.
NIEMAN, HENRY W.....27 West 44th St., New York, N. Y.
NUGENT, WILLIAM E., Colorado School of Mines, Golden, Colo.
O'NEAL, FRANK E..Gouleg Mountain Coal Co., Jodie, W. Va.
OLSON, VAN CLEAVE A.....Park City, Utah.
PERKINS, H. C., 1701 Connecticut Ave., Washington, D. C.
PONTON, G. M.....Westbrook Hotel, Fort Worth, Tex.
REA, JOHN E., States Oil Corpn., Box 216, Eastland, Tex.
ROBERTSON, FITCH.....Box 326, Metcalf, Ariz.
SANDERS, C. C.....Address wanted.
SANDS, W. E.....209 Ocean Front Ave., Venice, Cal.
SCHULER, HERMAN, Director, Agna Amarga Copper Co., Ltd., Vallenar, Chile, South America.
SHAYES, FRED P., Roxana Petroleum Corpn., Covington, Okla.
SMITH, GEORGE, Dept. of Mines, Sydney, N. S. W., Australia.
SMITH, RICHARD RAYMOND, Foreman, Moctezuma Copper Co., Pilares de Nacozari, Sonora, Mexico.
STARR, CHARLES C., Supt., Tonopah Divide Mine, Tonopah, Nev.
STODDART, A. W....1251 St. Andrews Place, Los Angeles, Cal.
STRANG, WILLIS B.....Box 1, Musselshell, Mont.
THOMAS, W. E., Cia Minerales y Metales, S. A., Apt. 251, Monterrey, N. L., Mexico.
TSEN, B. C.....Care Mrs. Cindburg, Sewaren, N. J.
TSENG, YIN LIAN.....Blinjoe Banka, Dutch East Indies.
TUCKER, A. W.....Salisbury, N. C.
TURNER, ALBERT.....Box 517, Iowa Park, Tex.
UDE, G. EDGAR.....Box 933, Morenci, Ariz.
WATSON, HUGH C., Michigan-Colorado Min. Co., Bedrock, Colo.
WATTS, BLYTHE D., Sec., Lynite Laboratories, Cleveland, O.
WILTSEE, E. A....Pacific Union Club, San Francisco, Cal.
WONG, YIN CHARLES, 414 W. 118th St., New York, N. Y.
WOO, Y. D., 521 Tompkins Hall, Columbia Univ., New York, N. Y.
YOUTZ, RALPH C., Calumet & Arizona Min. Co., Bisbee, Ariz.
YUAN, P. L., Care Mr. T. L. Yuan, Livingston Hall, Columbia Univ., New York, N. Y.
ZIEGLER, VICTOR, Colorado School of Mines, Golden, Colo.

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HARRISON W. CRAVER, Director

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## Book Review

**Wealth and Income of the American People.** By Walter Renton Ingalls. York, Pa., G. H. Merlin Co., 1922. 321 pp., 6 × 9 in., cloth, $4.

The author of this book needs no introduction to the mining and metallurgical profession, either as an engineer or as an economist. His economic writings have been widely published and commented on, but this is his first book on this subject.

Wealth and Income of the American People is, as the jacket says, a survey of the economic consequences of the war. The author's aim is to inspire others to examine with greater care many of the subjects treated so they may arrive at a fuller understanding of conditions as they exist today in our economic, financial and social structure. With this end in view, the author has examined critically the European situation from an economic standpoint and has analyzed the various foreign debts to the United States, not only as to amounts but as to the likelihood and desirability and consequent effect of the cancelling of those debts by the United States. The Russian situation receives particular attention. Foreign investments of American capital in all parts of the world as well as its loans to the Allies are carefully analyzed.

The middle third of the book is taken up with a discussion of statistics, the compilation of which represents much assiduous industry on the part of the author. He has woven them into the text in such an interesting manner that one is beguiled into subsequently reading the tables. The copious references to and quotations from authoritative economic works indicate the wide study of the author and the authoritative figures received by him from living persons well known in finance and industry add to the book a human interest which does not ordinarily attach to economic dissertations.

One of the most interesting sections of the book is devoted to an evaluation of the mines and metallurgical works of the United States, part of the calculations included having been published in MINING AND METALLURGY in October, 1921. Similar studies are made of all of the major factors in the wealth of the United States, of which only a few are mentioned here to show the scope of the list; gold and silver, farms, urban real estate, farming implements, live stock, railways steam and electric, express companies, pullman cars, telephones and telegraphs, tent cars, pipe lines and petroleum tankage, light power plants, automobiles, canals, etc., etc.

Most of the comforting fallacies of the war are exploded by the author. The war did not increase the efficiency of labor but, on the contrary, labor became more inefficient, more slack, and unions enforced rules entailing not only waste of time but of labor. "Throughout this period we fatuously fondled the illusion that we were becoming very rich, contemplating that the national income, expressed in dollars, was growing fabulously, attaining the huge total of sixty-six billion dollars in 1919. . . . We deluded ourselves with the agreeable fantasy that we could have as many automobiles as we wanted; but in reality we were living on our fat using up our principal, etc. . . . The cost of living did not outrun wages. Actually the result was the other way around."

In his summary the author says, "This thesis is primarily the showing that the world became enormously impoverished by the war, and that although the United States suffered less than any other country that was engaged, its position did not escape impairment. Consequently the people of the world are confronted with the prospect of a lower scale of living, which will be the case even in the United States. . . . . Things cannot be otherwise, for any idea that the people of the world could have bettered themselves by the destruction of wealth and the loss of man power by warfare is preposterous."

One of the grave dangers of the present time is pointed out to be the attitude of the owners of surplus plant in keeping it "partially in use with the hope of getting something out of it, maintaining the deplorable conditions of an industry with an aggravated and unnecessary overhead and part-time employment of its workers." He maintains that there must be faced the writing off of plant for the reason of its uselessness, either by virtue of superfluity or obsolescence. "At the present time American mining and manufacturing industry is immensely overbuilt. Among the major industries there are but few exceptions to this. The textile industry and anthracite coal mining are in the best positions, neither of these having any abnormal surplus of capacity. Next in order are electrical manufacturing and petroleum refining, which although largely extended during the last 5 years have been so with the sound justification of especially increased demand for their products. Pigment production (white lead and zinc oxide) is also in fairly good position. Among most of the other industries overbuilding ranges from 50 to 200 per cent. This includes copper production, zinc production, iron and steel, bituminous coal, heavy chemicals (sulfuric acid and caustic soda), boot and shoe manufacturing, clothing making, shipbuilding and automobile manufacturing. The last two are in the worst way. The uselessness of most of our shipyards is already commonly recognized."

On the subject of labor unions, the writer even foresees their dissolution. He says, "Hired labor has not yet had much readjustment in wage scales, its opposition to reduction in rates having resulted in extensive unemployment, owing to the inability of industries to pay the old scales. This spells, of course, curtailment of the national income. In a former paper I indicated the probability of just such a situation and pointed out how it would lead to dissension between the agricultural workers and the town workers, which has already happened; and how furthermore it would produce a rift between organized and unorganized labor; and how eventually it would lead to a dis

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ruption of the general federations of labor unions. I may go even further and foresee the waxing of the general principle of the open shop along with the waning of labor unionism."

"Labor is not going to continue to hold the mastery of the situation, in spite of declarations to that effect, but is going to lose most, if not all, of what it gained during the war and may fall to a lower scale of living than before the war. It may be that labor will lose even the 8-hour day under the economic compulsion of working more in order to meet the competition of pauperized Europe."

At dinner recently, a companion said to me, "Isn't it remarkable how Ingalls' predictions have been coming true?" Some of the factors in the present coal strike situation seem to be in a fair way of bearing out other of his forecasts.

The book is as calmly logical as a textbook but as interesting as a novel and leaves the reader with the conviction that the situations, although much worse than realized commonly, may yet be worked out if a fuller understanding of economic conditions is arrived at, governmental palliatives spurned, and common sense applied to the inexorable fundamental laws of economics.

P. E. B.

## Book Notices

**Blue Printing and Modern Plan Copying.** By B. J. Hall. London and N. Y., Sir Isaac Pitman & Sons, Ltd., 1921. 130 pp., illus., 5 × 8 in., cloth, $2.

Of interest to engineers who have plans to be copied, to installers of copying plants and to operators. The first section of the book discusses the capabilities of contact photography and allied processes for copying drawings, as well as the proper preparation of drawings for reproduction. Section two describes the machinery and apparatus used in blue-printing plants. The concluding section deals with the layout of blue-printing rooms and methods of working. Both contact and camera processes are included.

**Comprehensive Treatise on Inorganic and Theoretical Chemistry.** By J. W. Mellor. Vol. 1–2. London and N. Y., Longmans, Green and Co., 1922. 2 v., illus., 6 × 10 in., cloth, $20 a vol.

Volume one is mainly introductory. It treats of the evolution and methodology of chemistry, of chemical combination, atoms, molecules, and hydrogen and oxygen and their compounds. The second volume includes the halogens, the alkali metals and the ammonium compounds.

Subjects are treated with great fullness. Authorities are given for all statements of fact. The references to original publications are very complete. No work of similar character and completeness exists in the English language.

**Course in Electrical Engineering.** Vol. 2. Alternating Currents. By Chester L. Dawes. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. (Electrical Engineering texts.) 526 pp., illus., 6 × 8 in., cloth, $4.

An elementary textbook, intended as an introduction to more advanced books. For students who have such knowledge of direct currents as is given by volume one of this work, but have had no previous study of alternating currents.

**Distribution of Gas.** By Walter Hole. Fourth edition. London, Benn Brothers, Limited, 1921. 699 pp., illus., diagrs., 7 × 10 in., cloth, 50 s.

Uniform in size with Meade's "Modern Gas-works Practice," to which it forms a fitting companion. That work treats of gas manufacture, this takes up the account at the gasholder and discusses the distribution to the consumers' appliances.

The opening chapter discusses the rights and duties of gas undertakings. Succeeding chapters treat of discharges from pipes, station governors, districting, pipes and joints of iron and steel, mainlaying, valves and cocks, conduits, service pipes, meters, internal fitting, internal lighting, gas stoves and heaters, gas engines, industrial uses of gas, pressures, complaints and repairs, street lighting, high-pressure distribution, high-pressure lighting and heating, leakage, electrolysis and fusion. The information given is thoroughly representative of current practice. Obsolete matter was deleted in preparing this new edition and much that is new was added.

**Dynamic and Static Balancing.** By Edward K. Hammond. First edition. N. Y., Industrial Press; Lond., Machinery Publishing Co., Ltd., 1921. 58 pp., illus., 6 × 8 in., paper. $0.50.

A discussion of the principles of balancing, with a description of machines and methods, written in simple language. Intended for shop men. Avoids mathematical theory.

**Essentials in the Theory of Framed Structures.** By Charles A. Ellis. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 330 pp., tables, 6 × 9 in., cloth, $3.50.

Contains no new principles, but sets forth the fundamental ideas in very different way from that usually adopted in textbooks. Proceed from particular cases to general ones. Each principle is introduced by illustrative numerical problems, through the study of which the student is led to develop the general expression. The book requires little use of the calculus.

**Giesserei-Handbuch.** Herausgegeben vom Verein Deutscher Eisengiessereien Giessereiverband in Düsseldorf. München, R. Oldenbourg, 1922. 264 pp., tables, 7 × 10 in., cloth, 300 M.

Prepared by the German Ironfounders' Association as a convenient compendium of data used by foundry men. Includes the standards adopted by many European railroads, associations and societies, methods for the analysis of cast iron, coal, coke, slags and flue gases, physical data for iron and other materials, the German standards for cast-iron pipe, tariff and statistical data concerning the trade, trade associations, and directors of German foundries and foundry supply dealers.

**Heating and Ventilation.** By John R. Allen and J. H. Walker. Second edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 332 pp., illus., diagrs., tables, 6 × 9 in., cloth, $3.50.

A textbook for use in engineering and architectural schools, also for use as a handbook by engineers and architects. The text has been thoroughly revised and enlarged to include recent developments

**Hydraulics of Pipe Lines.** By W. F. Durand. N. Y., D. Van Nostrand Co., 1921. (Glasgow text books.) 271 pp., diagrs., 6 × 9 in., cloth. $4.50.

Intended to give a discussion, in engineering form, of the more important hydraulic problems which arise in connection with pipe lines and pipe line flow. No attempt is made to treat the subject structurally or descriptively. The successive chapters discuss general hydraulic principles, surge, water ram or shock, stresses in pipe lines, materials, construction, design, and oil pipe lines.

**Introduction to Physical Chemistry.** By Sir James Walker. Ninth edition. Lond., Macmillan and Co., Ltd., 1922. 438 pp., illus., 6 × 9 in., cloth, $4.50. (Gift of the Macmillan Co., N. Y.)

Intended for the student with some knowledge of chemistry and physics who wishes a work that will effect a connection between the knowledge he possesses and the works on physical chemistry.

**Ions, Electrons, and Ionizing Radiations.** By James Arnold Crowther. Third edition. N. Y., Longmans, Green & Co., Lond., Edward Arnold, 1922. 292 pp., diagrs., 6 × 9 in., cloth. $4.

This edition includes the results of recent work on constants, a fuller account of positive rays, and an account of the nuclear theory of the atom. The book is intended to be a reasonably complete account of the present state of the subject, suitable for students who wish a systematic knowledge of the late developments in physics.

**Mathematical Philosophy.** By Cassius J. Keyser. N. Y., E. P. Dutton & Co., 1922. 466 pp., 6 × 8 in., cloth, $4.70.

A course of lectures by the Adrian Professor of Mathematics at Columbia University. The author attempts to give an insight into the essential nature of mathematics regarded as a distinctive type of thought, to show what is characteristic and fundamental in mathematical method, acquaint readers with the great mathematical concepts that are available to laymen, and thus to give an understanding of mathematics in relation to the other sciences and arts.

**Modern Tunneling.** By David W. Brunton and John A. Davis. New Chapters on Railroad Tunneling by J. Vipond Davies. Second edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 612 pp., illus., 6 × 9 in., cloth, $6.50.

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Apparently a reprint of the first edition, published in 1914, with the addition of five chapters, comprising 157 pages, written by Mr. Davies. The original book contained data on American tunneling methods and equipment, but was restricted to tunnels of small size in which the heading was excavated at a single operation. The new matter deals with large tunnels for railroads and highways, both subterranean and subaqueous. Extensive bibliographies are included.

**Petroleum.** By Sir Boverton Redwood. Fourth edition. Lond., Charles Griffin & Co., Ltd.; Phila., J. B. Lippincott Co., 1922. 3 vol., maps, plates, illus., tables, 6 × 9 in., cloth, $39.

Sir Boverton Redwood's classic work is the product of a long professional career as a petroleum technologist. The material collected, after being critically sifted in the light of his broad experience, resulted in a book that for 25 years has been recognised as an authoritative reference work.

The present edition was in preparation when the author died in 1919, and certain parts had received his final revision. The remainder has been revised by his friends, and the work has been seen through the press by A. W. Eastlake and Robert Redwood.

Commencing with a historical account of the industry, the distribution, physical and chemical properties, and origin of petroleum are discussed in volume one. Volume two is devoted to production, refining, transportation, storage and distribution, and to the shale oil industry. Volume three treats of testing, uses, and laws; it also contains statistics, import duties and an extensive bibliography. This contains nearly nine thousand references; but seems to include few, if any, publications later than 1911.

**Practical Chemistry of Coal and Its Products.** By A. E. Findley and R. Wigginton. London, Benn Brothers, Limited, 1921. 144 pp.,-diagrs., tables, 6 × 9 in., cloth. 12 s. 6 d.

A collection of reliable methods for analysing coal, coke, ammonia liquor, benzene, coal tar, water, gas, and similar products and raw materials of the gas and coke industries. Based on the course in fuel technology at Sheffield University.

**Probenahme und Analyse von Eisen und Stahl.** By O. Bauer and E. Deiss. Zweite auflage. Berlin, Julius Springer, 1922. 304 pp., illus., 7 × 10 in., cloth, 472 M.

Presents methods for sampling and analysing iron and steel adopted by the authors for their work at the National Testing Laboratory in Berlin. The first section, by Prof. Bauer, discusses sampling, emphasizes the importance of proper sampling and gives much information upon proper methods of taking, polishing and etching samples for microscopic examination. The metallographic characteristics of the constituents of iron and steel are described and directions given for securing representative samples of iron and steel for examination. The second section, by Prof. Deiss, gives reliable methods for the accurate chemical determination of the various constituents of iron and steel.

**Questions and Answers Relating to Diesel, Semi-Diesel and Other Internal-combustion Engines, Air Compressors,** etc. By John Lamb. Lond., Charles Griffin & Co., Inc.; Phila., J. B. Lippincott Co., 1922. 209 pp., 4 × 5 in., cloth. 5 s.

A small pocketbook of practical information for steam engineers and others preparing for license examinations.

**Real Mathematics.** By Ernest G. Beck. Lond., Henry Frowde and Hodder & Stoughton, 1922. (Oxford technical publications.) 306 pp., diagrs., 5 × 8 in., cloth, 15 s. (Gift of Oxford University Press, American Branch.)

This book is intended to assist in the acquisition of a real, serviceable, sound mathematical equipment, by augmenting standard textbooks and orthodox methods of study. The author hopes it will contribute toward the adoption of a change of attitude toward mathematics by those who require it as a part of their working equipment, by showing it as an actual, tangible reality, instead of a collection of rigid and unrelated rules and formulas. The method given assists the student to visualize the various operations and processes used in mathematical calculation.

**Textbook of Fire Assaying.** By Edward E. Bugbee. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 254 pp., illus., 6 × 9 in., cloth.

Based on the course at the Massachusetts Institute of Technology and intended as a college textbook; but will also be useful to more mature students. An endeavor has been made to give the scientific reasons underlying the phenomena that occur and the rationale of the processes and manipulations.

**Textbook of Mineralogy.** By Edward Salisbury Dana. Third edition, revised and enlarged by W. E. Ford. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 720 pp., illus., 6 × 9 in., cloth, $5.

It is 24 years since the second edition of this work appeared. The changes involved in the present edition are chiefly those of addition, the general character and form of the book remaining unchanged. The methods employed in the use of the stereographic and gnomonic projections have been introduced into the section on Crystallography. The section on the Optical Characters of Minerals has been rewritten. All new species have been briefly mentioned in their proper places in the section on Descriptive Mineralogy.

**Zirconium and Its Compounds.** By Francis P. Venable. N. Y., Chemical Catalog Co., Inc., 1922. (American Chemical Society Monograph series.) 173 pp., 6 × 9 in., cloth, $2.50.

A concise account of present knowledge of the chemistry of zirconium and its compounds with other elements. Methods for the analysis of zirconium compounds, and chapters on technical applications and patents are included. An extensive bibliography is given.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

Positions of the Bureau are on file in the offices of the member societies of the Federated American Engineering Societies and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Geologist** with superior training and recognized professional standing, who had had ten years successful experience in scientific investigations and practical economic work in oil, coal, and mineral deposits, desires position as chief of geological department of reliable company or institution. IM-1574.

**Metallurgical Engineer.**—School of Mines graduate. Has done practically every thing around mine, mill, copper and lead smelters, up to superintendent of large works. Experienced in leaching and volatilization methods. Can help solve difficult ore-treatment problems. Good organizer, and can handle both American and Mexican labor successfully. Age 35. Married. IM-1575.

**Metallurgical Engineer.**—Graduate. Experience as chief chemist, cyanide-mill superintendent, flotation superintendent, construction engineer, production engineer and in iron blast-furnace operation. Age, 33. Minimum salary $300 per month in United States. For foreign work, $500 per month. IM-1576.

**Superintendent.**—Twelve years' experience Ohio and West Virginia coal mines, examination, surveys, construction and operation. Married. Age 36. IM-1577.

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**Mining Engineer.**—Design and construction of coal tipples, power plants and general machinery. Surveying, mapping and general coal-mine development. Experienced draftsman in all work. IM–1578.

**Quarry and Open-cut Operator.**—Has made specialty of surface mining of large orebodies, big tonnages and low unit costs. College man, age 39, married. Eight years in the United States and seven in Mexico, in gold, silver-lead and copper properties, underground, surface operations, construction, efficiency and cost analysis. Speaks Spanish fluently. IM–1579.

**Mining Geologist.**—Harvard graduate. Five years experience, petroleum and mining geology in United States and Africa. Accustomed to handling prospecting operations. Thoroughly acquainted with diamond drilling. Wishes position leading to responsible executive in directing mine development. IM–1580.

**Mining Engineer** wants summer work. College and technical graduate. At present instructor in mining, having had five years experience in practical underground, efficiency, valuation, operating, and educational mining work. Age 33. IM–1581.

**Chemical Engineer.**—Seven years as production superintendent in Chile. Experienced in leaching ore, treatment of slimes, filtration, etc. Thoroughly familiar with Spanish. Wants opportunity for advancement. IM–1582.

**Mining or Manufacturing.**—Technical graduate at present engaged in factory management control—3 years engineering and manufacturing experience—invites offer for position as sales engineer, secretary or assisiant to executive who is a developer of ambitious men. Age, 26. Unmarried. IM–1583.

**Manager or Superintendent.**—Graduate. Seventeen years experience, development and operation of mining properties. Ten years with present company in Mexico. Speaks Spanish. IM–1584.

**Chemical and Electrochemical Engineer.**—Experienced in production of phosphoric acid from natural phosphate rock, both by sulfuric acid decomposition and electric furnace volatilization methods; also in manufacture of various phosphate compounds. Age 34. Married. IM–1585.

**Junior Engineer.**—Available June 15 after graduation from M. I. T. Two years experience in mining and engineering. IM–1586.

## Positions Open

**Instructors.**—Engineers willing to consider teaching positions are invited to register with the Employment Service, which has been called on to fill positions varying in grade from laboratory assistant to heads of departments in various engineering and technical schools of this country. Blanks for registration and information regarding the Bureau may be obtained from Walter V. Brown, Manager Employment Service, 29 West 39th St., New York City.

**Draftsmen.**—Mining engineers qualified to fill structural and architectural drafting positions will please apply at once to Walter V. Brown, Manager Employment Service, 29 West 39th St., New York City.

**Mine Foreman.**—Bituminous-coal mining experience. Scientific management experience essential. Pennsylvania. V–355.

**Chemist** who has actual practical knowledge of manufacture of aluminum sulfate. Man who has experience and can go right ahead with commercial process. Apply by letter. New Jersey. V–622.

**Mine Superintendent.**—Thorough practical working knowledge of Spanish language and experience in handling Mexican workman. Graduate mining engineer. Personality and executive ability sufficient to organize, direct, and efficiently operate group of mines producing approximately 600 tons of ore per day. Must have had experience in handling heavy ground. Must be diligent and enthusiastic worker. Send full record of past experience, education, and qualifications. If married, state whether applicant would wish to take family to Mexico. Attach photograph if possible. Mexico. V–704.

**Research Chemist and Metallurgist.**—Technical graduate with broad experience in laboratory and research metallurgy and ore dressing. Knowledge of Spanish language desirable, but not essential. Must have knowledge of cyanidation of silver and gold ores; also of concentration and flotation. Send full record of past experience, education, and qualifications, if married, state whether applicant would wish to take family to Mexico. Attach photograph if possible. Mexico. V–705.

**Professor of Chemistry** and assistant professor of metallurgy, to have charge of chemistry department but work in metallurgy under supervision of present professor of mining and metallurgy. Age at least 30 years. Practical experience in chemistry and metallurgy. Electro-metallurgy if possible. Experience in college teaching. Year begins Sept. 1, 1922. Possibly work can be arranged for man to teach chemistry during summer session, outside regular contract. Apply by letter. New Mexico. V–706.

**Solicitor** who understands foundry practice to solicit jobs in non-ferrous castings. Apply in person. Salary and commission. New York City. V–747.

**Practical Builders** for small stone residences. Small investment necessary. No foreign language necessary. Good climate. Apply by letter. Dutch West Indies. V–752.

**Mine Foreman.**—Three years contract. Transportation paid both ways. South America, high altitude. Apply by letter. V–785.

**Mine Shift Boss.**—1920 graduate will be considered. Three men needed. Three years contract. Apply by letter. South America, high altitude. V–786.

**Mining Engineer** with safety and industrial relations experience for copper smelting and refining plant. New Jersey. V–809.

**Mechanical Engineer** or high-class master mechanic to take charge of foundry shops and machinery of large mining company operating in Mexico. Must speak Spanish and furnish good references. Prefer one who has held responsible position in mechanical department of large mine in Southwest or Mexico. Salary commensurate with position and experience. Apply by letter. V–818.

**Sales Manager.**—Desires to enter partnership with manufacturer to build up business. Willing to invest capital and take entire charge of marketing product. Age 37. V–762.

**Metallurgist** familiar with iron and steel research work. Age 35. New York City. V–906.

**Chief Mine Engineer,** Maryland Bureau of Mines. Salary five thousand. Apply to State Employment Commission, 22 Light St., Baltimore, Md. V–1080.

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**Specifications** for the various refined petroleum products purchased by the Federal Government are given in Technical Paper 305, just issued by the U. S. Bureau of Mines. The specifications cover motor gasoline, aviation gasoline, naphtha, kerosene, signal oil, fuel oils, lubricants, etc. These specifications have been officially adopted by the Federal Specifications Board. They supersede the specifications published in Bulletins 1 to 5, inclusive, of the Committee on Standardization of Petroleum Specifications.

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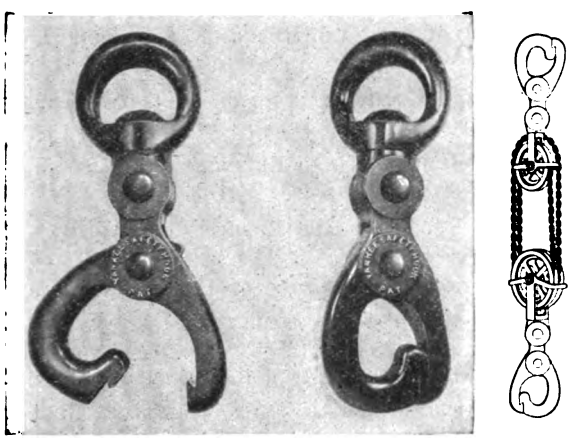
# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

## Safety Hoist Hook

AN INTERESTING form of hoist hook is made by the Frank W. Trabold Co., 30 Church St., New York. It is called the Yankee safety hook and is made in five sizes, from 1 to 25 tons capacity.



YANKEE SAFETY HOOK, OPEN, CLOSED AND ATTACHED TO A CHAIN HOIST.

This hook cannot straighten out nor unlock while under tension. It cannot be attached to a load unless it is locked into position, and cannot be unlocked until the load is safely landed.

The body parts are drop forged from high-grade steel, and Monel metal rivets insure high resistance to shearing strain.

## Caterpillars for Railroad-type Shovels

THE Bucyrus Co. of South Milwaukee, Wis., announces that it is prepared to equip all sizes of railroad-type shovels with caterpillar traction.

This mounting consists of two forward caterpillars, replacing the jack arm, and two rear caterpillars mounted under the rear of the shovel.

The front caterpillars are designed to swivel and adjust themselves to unevenness of the ground. Both front caterpillars are drivers.

The rear caterpillars consist of two units mounted on the same frame. They are strong enough to cross holes and ditches without the delay incidental to filling in.

Steering is done through the rear caterpillars. The massive steering arm is integral with the pintle of the rear caterpillar trucks. It carries a heavy gear segment which engages a pinion on a vertical shaft. It is driven by an independent center valve, reverse type engine, suspended underneath the car frame. This engine may be operated either from the operator's stand or from ground alongside the rear caterpillars.

Propelling is done by the front caterpillars. These may be driven together or each one independently, forward or backward. The propelling speed is about ½ mi. per hr. The tractive power is sufficient to enable the shovel to climb with ease 15 to 20 per cent. grades.

Over one hundred caterpillar-mounted Bucyrus machines weighing from 65 to 220 tons have been sold within the past eight years and are operating with unqualified success.

## Industrial Notes

**Combustion Engineering Corpn.,** New York, announces the opening of a branch office at 1137 Guardian Bldg., Cleveland, Ohio. This office will be in charge of Frank Henderson, who has been with stoker companies in that territory for many years.

**Minerals Separation North American Corporation.**—John Ballot, president of the Corporation, died on April 1.

**Uehling Instrument Co.,** manufacturers of $CO_2$ recorders and other fuel economy equipment, may now be reached at 473 Getty Ave., Paterson, N. J., instead of at 71 Broadway, New York.

**Dayton-Dowd Company, Quincy, Ill.,** manufacturers of centrifugal pumps, announce that A. P. Blackstead, formerly chief engineer of the Camden Iron Works, Camden, N. J., and prior to that hydraulic engineer with the Henry R. Worthington Co., New York, has joined the engineering staff of the Dayton-Dowd Company. Mr. Blackstead has had broad experience on centrifugal pumps for over 20 years, in this country and abroad. He recently returned from Europe, where he spent six months studying conditions and investigating recent developments in hydraulic engineering.

**Vanadium Corporation of America,** 120 Broadway, New York, about two years ago began an extensive series of tests and research to produce better drill steel, and has recently issued a condensed report of comparative tests on vanadium drill steel and FJAB Swedish steel. The report shows superiority of vanadium steel over the Swedish steel in resistance to failure from shock and fatigue.

## Trade Catalogs

**Deppé Motors Corpn.,** 151 Church St., New York.—Folder on Deppé Superheat System for operating Midwest Internal Combustion Engines.

**Aldrich Pump Co.,** Allentown, Pa.—Data No. 27 on Selective Fittings. Described uses and applications of articles that may be used to advantage in connection with the Aldrich pumps.

**Templeton, Kenly & Co, Ltd.,** 1020 South Central Ave., Chicago, Ill.—Bulletin 122, illustrating and describing Simplex Jacks. This bulletin gives information of interest to all users of jacks.

**Uehling Instrument Co., Paterson, N. J.**—Bulletin 112, covering Uehling $CO_2$ Recording Equipment, for guiding the engineer and fireman in reducing the waste of fuel up the chimney. Particular attention is called to the recently developed "Pyroporus" filter, which keeps the gas-sampling lines clean. Other noteworthy features are the separate recorder for the engineer's office and indicator for the boiler-front continuous (not intermittent) chart record and dry method of absorption.

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# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

Organized 1871. Incorporated 1905

The aims and purposes of the Institute are to promote the arts and sciences connected with the economic production of the useful minerals and metals and the welfare of those employed in these industries.

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† Expires in June instead of February.
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# MINING AND METALLURGY

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## SEPTEMBER MEETING IN SAN FRANCISCO


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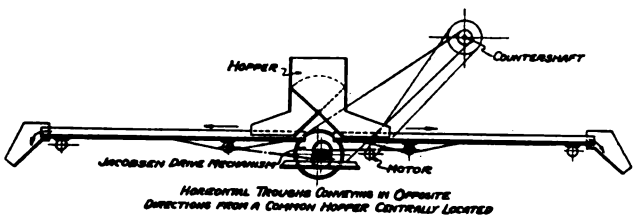

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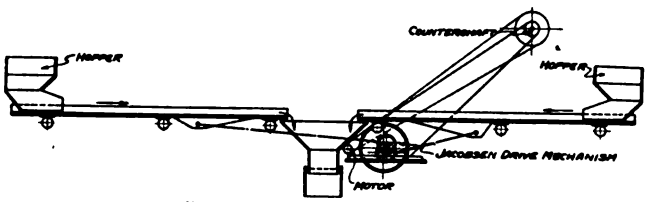

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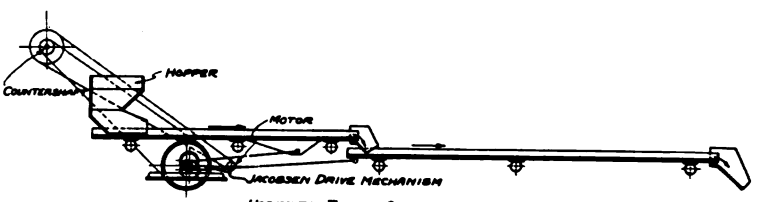

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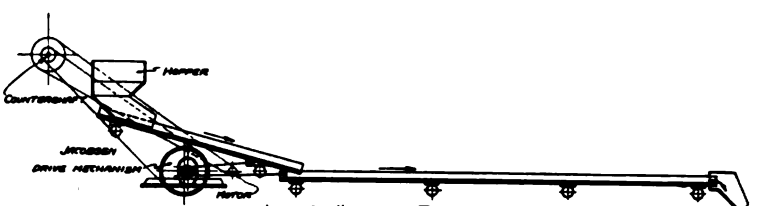

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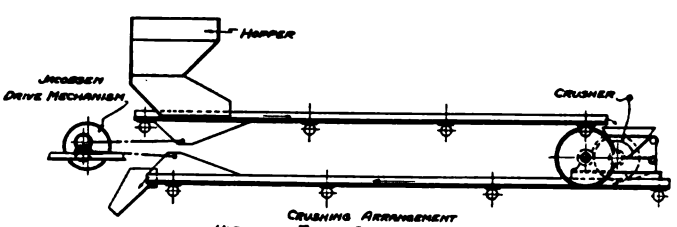

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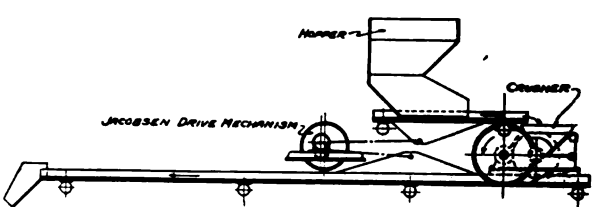

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# MINING AND METALLURGY

THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
29 West 39th Street, New York City, N.Y.

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PERCY E. BARBOUR, Managing Editor.



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## EDITORIAL

### How do Things Stand in Europe?

IN THIS magazine for April, I reviewed the economic position in the United States, as it then looked to me. Nothing has happened since then to induce any modification of my views. Now, as the Genoa conference draws to a close, it is important to examine the situation in Europe, for regardless of the contempt for foreign trade that some thoughtless persons profess, and the *insouciance* with which many seem to think that the United States can "go it alone," leaving Europe to muddle in its own mess, the sober fact is that our fortunes are intertwined with those of Europe irrespective of whether we like it or not.

It is now three and one-half years since the Armistice. Hypothetically, a good deal of readjustment should have been accomplished in that time; practically, this could not begin immediately. In our own country the immediate aftermath of the war did not come to an end until the middle of 1920, and we did not begin to appreciate the stern realities until about the following November. We are not three and one-half years along with our readjustment, but only about one and one-half years. Something like this, also, is the case with Europe. Many of its countries did not appreciate what was confronting them until their American credits were exhausted (about the middle of 1920), which precipitated our own debacle.

It is commonly agreed that the prosperity of a country, like that of an individual business, is a function of its productivity. Unfortunately, the latter can not be easily measured for a country. If it could be done at frequent intervals we should have means for determining the state of general business. It is attempted, in default of any better method, to do this indirectly, by examining such data as bank clearings, car loadings, the production of some basic commodities, etc., and perhaps by making composites of such data. Reflection will lead to the conclusion, however, that none of those factors has an inherent coincidence, or true correlation,



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with general productivity. But there is one which does possess such a correlation and that is the employment of labor. Production is indeed a direct effect of the exercise of labor. Not only is this theoretically true but also have statistical comparisons between physical production and labor employment proved it to be true.

In considering mere statistics of numbers employed, however, it is necessary to introduce modifying factors, which may be characterized as factors of efficiency and which may be plus or minus. We may not be able to determine those factors numerically, but we can generally form ideas of their nature. This is prefatory to reporting the observation that in most of the industrial countries of Europe the percentage of employment is still very low, that in none of them has there been exhibited any strong tendency toward increase, and that in some of them things have manifestly been going from bad to worse. Let us now examine the positions with some detail, for in them we shall find much of what disturbed the Genoa conference and also much that has a direct bearing on our own affairs.

In Great Britain the rate of employment was high during 1919 and 1920, but in the latter part of 1920 it dropped precipitously to about the middle of 1921, when a minimum of about 80 per cent. was reported. Following this there was a slight increase during several months and then another decline to about 81 per cent. Since the beginning of 1922, there has been a slow increase. Along with this there has been an increasing volume of physical production, an improvement in sentiment, a rise in the stock market, and, in short, an exhibition similar to what we have concurrently experienced in the United States. The percentage of employment and the volume of business in Great Britain are still very subnormal, however.

In Belgium, the line followed a similar course during 1921, but from the depth of depression in that year there has been a pretty steady upward movement.

In Sweden, on the other hand, things started sharply down hill in the latter part of 1920 and have continued to go down ever since.

Germany showed a fairly high rate of employment throughout 1919 and 1920 and during the second half of 1921 attained a very high figure indeed, but there has been some recession from the peak attained in October, 1921.

Definite data are available only from the foregoing countries, but general information from other countries is of similar character. The situation in Spain has been becoming increasingly bad. In Italy and Switzerland, also, it has been bad. In Austria, it has been, and still is, chaotic. In France, there appears to have been a high rate of employment. The countries of southeastern Europe seem to have been getting on pretty well. Russia, of course, is in a desperate way.

It is now necessary to modify the data of numerical employment by the factors of efficiency. In a general way it may be declared with certainty that the efficiency in every country of Europe is subnormal, *i.e.*, if the production of 3000 work-hours per man under pre-war conditions were 100, the present rate of production is a percentage thereof, varying in the several countries. This is a consequence of malnutrition and impairments resulting from the war, of unsound economic spirit and of unwise legislation.

In Germany, although the rate of employment is high, the efficiency of work is low. This is brought about by the several evil factors that have been mentioned, among which, under the head of unwise legislation, is to be included the 8-hour day. One of the first edicts of the revolutionary government in 1918 was to fix a daily working time of 8 hours and a weekly time of 48 hours. By arrangements between employers and trade unions, the latter representing more than six million workers, a working time of less than 48 hours per week has been established in a large part of the mines and factories. The German Government is now considering replacing the decree by a law, but the employers are protesting, representing that in most industries the expected increase in productivity has not been realized, but that on the contrary there has been a falling off, and they attribute this materially to the 8-hour day.

In France, also, with a high rate of employment, there has been a similar deterioration in work done, and this too is ascribed largely to the 8-hour day, which on Apr. 23, 1919, was made mandatory in all branches of industry. The hypothesis that the worker would be so invigorated by rest and relaxation that he would do in 8 hours more than formerly in 10 or 12 has not proved to be true, if we may rely on the conclusions of a distinguished French economist. On the contrary, the reverse has been the fact, the output having become smaller in quantity and poorer in quality. Data recently presented in the Chamber of Deputies showed reduced production in various industries ranging from 20 to 40 per cent., all ascribed to the 8-hour legislation.

In Great Britain, too, there has been reduced efficiency, but there seem to be signs of a "come-back," by dint of necessity, the British worker apparently becoming appreciative at last of the principle of nature that is expressed in the old homely phrase, "Root, hog, or die." Even is there evinced a willingness on the part of the men to go back to zinc smelting, which had become a dead industry, and not only to accept such work but also to try to be efficient and happy in doing it.

It is only in the small countries of southeastern Europe that there has been any fair degree of recovery from the effects of the war. Their resuscitation is ascribable to their being essentially agricultural countries, rather than industrial, wherefore their scars have been capable of relatively quick healing. Russia, although mainly agricultural, is nearly dead by virtue of its communistic experiment. So long as this prevails, with its stand against private ownership of property,

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Russia is doomed to eternal poverty. Among the other major countries of Europe, France and Italy do not figure so greatly in the world's economic complex, for the reason that their peoples lead lives that are more or less self-contained. It is upon Germany and Great Britain that attention must focus. Their foreign trades are necessarily large, for their very lives depend on their people working for those in other parts of the world. They must take in great quantities of food and raw materials and send out manufactured products. In other words, the main basis for their livelihood is the sale of their work, and conditions preventing that may not only prevent prosperity but also may curtail the ability to live.

Herein we find the explanation of the political maneuvers that exhibited themselves at Genoa. Great Britain is constrained to do everything possible to get the wheels of industry in motion without much attention to any likes or dislikes. Germany, with some of its most important industrial regions trimmed off and with a congested population, must also seize upon any available expedients. An arrangement between Germany and Russia in itself is not to be deprecated, for Russia is a natural outlet for German activities and the development of such will be beneficial to the whole world. The objectionable thing about the Rapallo treaty was its consummation without the supervision of the other powers. France is not under the same pressure as Great Britain, but it is semi-bankrupt and hopes only to survive by obtaining the maximum of reparations from Germany. France, moreover, is determined to preclude the possibility of any further military aggression. Thus the interests of Great Britain and France are quite different and so far no formula for reconciliation has been found.

The Soviet Government of Russia, seeking to preserve itself, is in desperate need of a large loan of funds and its delegates went to Genoa to get it. They were permitted so to play their hand as to make Russia the main issue and incidentally produce splits among the other powers. This was unfortunate, for the immediate importance of Russia to the rest of the world is greatly overestimated. At the moment, it is Russia which needs the assistance.

Our Government in Washington had a keen discernment of these conditions and wisely refrained from going to Genoa. America holds the key to the whole position in so far as Russia is concerned, for no other nation is capable of extending the credits that Russia needs. The American position is clear cut against extending any credit to the present government of Russia. Popular opinion in this country would not sanction any governmental loan and any attempt to finance private loans with a government that does not recognize private rights in property would be preposterous. The American investor would view loans to such a government as equivalent to giving away his money.

It is an illusion that the redevelopment of Russia will contribute immediately in an effective way to improving the welfare of the world. For the moment, it is Germany that has the most economic concern with Russia, next Great Britain, and America least of all. The essential conditions for restoring commerce and industry in Europe and upholding a decent scale of living for the several peoples are an assurance of peace, a fixing of German reparation payments so that they can be met in a reasonable way, a balancing of budgets by every government, and the inauguration of rigid economy by everybody. But underlying everything else is the need of harder work and more productivity in all quarters. "There is one remedy—an infallible remedy—that will solve all our world problems," said Lord Leverhulme, recently, "and that is work, and then more work, and then to forget that there is such a thing as a problem." During the war there crept into the minds of people, both in Europe and America, the idea that in some way it was possible to get a living without working, or anyhow without working very hard. This was a reflection of the economic fallacy that there is somewhere a great fund of money out of which wages are paid. This fallacy still prevails. It is encouraging, therefore, to read of J. R. Clyne, the distinguished and very intelligent labor leader in Great Britain, talking to his followers like this: "At present workmen assume a sort of monstrous reservoir from which they can draw whatever wages are desired. If the worker has to choose between more output or less pay, he should be content to pick the former and so increase the purchasing power of his earnings. Unfortunately, in the minds of many workmen there is a lack of even the elemental facts of political economy, a state that the future educational systems must remedy."

W. R. Ingalls.

## Exempting Those Who Don't Want to be Licensed

AT THE February meeting of the New York State Board of Licensing for Professional Engineers and Land Surveyors, appeared a delegated committee of the County Highway Superintendents who saw jeopardy to their jobs in the Licensing Law. They are building 69,000 out of the 80,000 miles of improved highways in New York State, but few of them have engineering training, one of the committee, in fact, being a doctor. The committee informed the Board, in so many words, that it would do better to license them "with your eyes shut" than to have them repeal that section of the law providing that state and county, etc., construction work in excess of $2000 must be done by licensed engineers.

They had taken time by the forelock, and their various friends in the State Legislature had introduced, and there were then pending, eight different bills

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amending or repealing the section offensive to the political office holders, some of whom had successively retained their elective positions for 13 years.

Members of this committee argued that to have held these positions for such long periods they must of necessity have been doing the work satisfactorily, although they estimated variously that 75 to 99½ per cent. of their time was devoted to general business and caring for political friendships and related matters.

One interesting question growing out of this is: Does ½ per cent. of a doctor's time during, say, 10 years devoted to road work make a highway engineer of him and entitle him to a license as a Professional Engineer?

If there is any virtue in licensing engineers "in order to safeguard life, health and property," it seems evident a most fitting field for its application would be in the expenditure of the public's money in public engineering and construction. However, the Legislature kindly passed an amendment to the offensive section, reading in part "this section shall not apply to the construction, improvement or maintenance of county roads or town highways," thus exempting County Highway Superintendents. If you are a trained engineer, you must take out a license before you may with safety to the public "life, health and property" build state highways, bridges, etc., but if you are a country doctor elected to county highway superintendency you may do highway engineering (*sic*) with only a split-log drag and the complacency born of a solid constituency. How much of the public's money might have been saved, might yet be saved, if all county road building, 69,000 miles, were to be done by trained engineers?

There were only 57 of these county highway superintendents for whose benefit this amendment was enacted. What possibilities are opened up for other groups of more numerous engineers, the mining engineers for instance, who are also opposed to licensing based on much firmer arguments than political expediency? PERCY E. BARBOUR.

## Fall Meeting of the Institute

THE Board of Directors, on May 19, voted to accept the invitation of the San Francisco Section to hold the regular fall meeting of the Institute in San Francisco.

The week beginning Sept. 25 has been chosen as the time for this meeting. It is hoped that a program will be sufficiently advanced to enable a more detailed statement to be printed in the July MINING AND METALLURGY.

Members will please bear in mind that all announcements respecting the fall meeting will reach them through the pages of MINING AND METALLURGY, at the regular intervals of its publication.

FREDERICK F. SHARPLESS.

## Our Greatest Investment

AT THE February meeting, the president, under specific authorization of the Board of Directors, appointed a committee of five to coöperate with the War Department in the matter of Industrial Preparedness with particular reference to war minerals, but in the widest significance.

The Institute's activities in the matter of preparedness in time of peace should not be limited to the efforts of five men and a patriotic president, despite the considerable results we may confidently expect them to accomplish. Too many of our members served in the army as engineers in the last war to have the emasculation of the present army and our National Defense Act a matter of no concern to them and the Institute now.

Our members are concerned directly and indirectly, through their patriotism, through their mining interest, through their taxes, through desire for adequate protection of their foreign mines and investments, in the blind wave of pacifism which is urging Congress to wreck our present military system.

Would that further wars were impossible, but with present world conditions more pregnant of war than at any time of peace, within memory it is an engineering and economic crime to scrap the only adequate National Defense Act we ever had. Read Upton's "Military Policy of the United States" if you would learn how near ruin we have come in every war, despite the undisputed and unequalled valor of the American soldier, because we had a weak, vacillating policy or none at all. A moiety of the money we are still spending as the result of mistakes in past wars, if now spent in adequate preparedness, would do more to make future war impossible than any other course the human mind has conceived.

Putting aside, if you will, all thought of humanism, race advancement, and all the altruisms we dream of or aspire to, it means more to your personal comfort, happiness and your own pocketbook to spend a dollar to prevent war by suitable preparedness than to go through what we are going through now in post-war costs, taxes and troubles which take all the dollars the members of the profession can now earn.

This preparedness can be accomplished cheaply if Congress can be made to see that the people of this country want it. And to whom is Congress most responsive? To the communications from constituents.

President Dwight's committee of five will spend many hours working on questions vital to you and your hopes and projects and prosperity. You can help them vastly by spending a few minutes dictating a few letters to your Congressmen and Senators, telling them you and your community want proper preparedness. Legislators never were as heedful of the mandate of popular opinion as now.

PERCY E. BARBOUR.

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# Review of the Month

MAY began with a general strike of the bituminous and anthracite coal miners in the United States in progress, while in Great Britain about three quarters of a million workers became idle by a lockout, caused by a dispute respecting the question of the rights of management in their shops. The employers opened their shops on May 3 to men wishing to resume work, but few availed themselves of the opportunity. Up to this time the statistics had been showing a little increase in the rate of employment in Great Britain and business conditions were considered to be improving.

From Russia came reports that the results of the famine had not been so bad as had been prophesied, which is not to say that they were not grievous. In prognostications such things are habitually overestimated. Seeding for the new crop has now begun in Russia, with hopes for better results than last year. However, the general economic situation in Russia steadily becomes worse. We had advices during May to the effect that the Soviet Government had decided to abolish the gold ruble even as a theoretical calculating unit and substitute a "goods index." This idea would be somewhat on the lines of Professor Fisher for stablizing the dollar, and there may be a chance to see how it will work in practice. There was a contradictory report from Russia, however, that it had been decided to revert to the gold basis. This is the more plausible report, for if there be anything to be deduced from economic theory and history the present paper rubles will completely collapse and return to gold basis will ensue simply because the people will refuse to sell their goods on anything else.

The civil war in China came to a head during the first week in May when General Wu-Pei-fu crushed the forces of General Chang Tso-lin around Pekin. The victor declared his intention to be to reunite the North and the South and in course of time to arrange for a constitutional convention. We probably do not understand the conditions in China, but recent events do not appear to have solved the grave difficulties there, though they may be a step toward it. However, the immediate outlook does not appear good, General Chang having retired to the north and declared the secession of Manchuria and Mongolia.

In the south of China there have been troubles, financial and otherwise. We do not reconcile all of this, however, with the better buying of silver from the Orient, which put up the price to 72¾ cents. Of course, this has been due largely to India, which is now able to draw gold from either England or America, evincing thus an increased purchasing power.

The Germans replied to the Reparation Commission's note of last March, saying that the commission's demand for sixty billion paper marks of new taxation cannot be complied with "before May 31," but that Germany is prepared to submit before that date "a complete scheme to cover expenditure without further monetary inflation." The reparation payment of 15,000,000 gold marks, due May 15, was made on that date.

The great event of May was, of course, the Genoa conference. Right from the beginning this resolved itself into an attempt to arrange some understanding with Russia, rather than a consideration of general economic conditions. A state of consternation developed when a separate treaty between Russia and Germany, surreptitiously negotiated, was announced. This was viewed by the great powers as a breach of faith on the part of the Germans and may be annulled by *force majeure*. However, things were smoothed over temporarily and negotiations proceeded, with strong prospects of disruption of the *entente* between Great Britain and France, but finally the Russians made such an impossible reply to the allied overtures that everyone united in the opinion that there was nothing to be done and the conference came practically to an end.

There was a proposal to wind up the Genoa Conference and resume conversations at the Hague in June with the idea of appointing a commission to investigate Russian affairs. The United States was invited to participate in the conference at the Hague, but Washington refused on the same grounds as previously. This met with the hearty approval of France.

An event of much importance to the metal industry was the signing at Geneva, May 15, of a treaty between Germany and Poland arranging the economics of Upper Silesia. The League of Nations award, while providing for the political partition of this great industrial province had recognized nevertheless that its economic unity should be preserved. The new treaty establishes that for the next 15 years the distribution of coal, water power, and electric power, the operation of the railroads, and postal communications are to continue as if Upper Silesia were under a single suzerainty. It is a difficult experiment, but it is necessary for the successful operations of the industries.

In the United States, business has become very good in some branches, fairly good in others, but continues poor in many. There is the greatest activity in building, automobile manufacturing and automobile tire making. The wooden industry is moderately active.

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Cotton spinning is active in the South, but is slow in New England, even in those places where operations have not been checked by strikes. There is a similar situation with respect to shoe making, which is active in St. Louis and the Middle West, but is very dull in New England.

In agriculture, although there has been an improvement in the position of the farmers this has not been sufficient to overcome their troubles. It is to be borne in mind that the rises in prices for agricultural products came after last year's products had passed largely out of the hands of the farmers and had been largely consumed. Moreover, the recent advances in the prices of cotton, corn and wheat have been more or less in anticipation of poor harvests this year.

Business failures have declined slightly although they are still abnormally high. Retail trade is not active in any part of the country and recently has exhibited declining tendencies. The last mentioned feature is in accordance with another factor which makes a negative instead of a positive sign, *viz.*, the decline in the Federal reserve currency that is in circulation, there having been a reduction of about $286,000,000 from the first of January to the end of April this year. This implies a contraction of cash turn-over, not an expansion. Other data raise the question whether business has really improved so much as in building houses and motor cars.

The increase in the volume of the iron and steel business is of course directly explained by the increased building of houses, manufacture of automobiles and to a less extent the increased construction of locomotives and railway cars.

The behavior of the metal markets is a direct reflection of the events as hereinbefore outlined. Lead has been distinctly the strongest of the principal metals. It is called for extensively in house building, both for painting and plumbing. It is called for, moreover, in automobile construction and operation.

For the same purposes steel is especially in demand. House building does not call for very much copper. Automobile construction requires a good deal, but the increased demand for copper from that quarter has been to a considerable extent offset by the decrease in shipment. The electrical manufacturing industry, which is the great mainstay for copper, has shown a little improvement, but not very much.

Commercial loans by the banks that report weekly to the Federal Reserve Board have shown a reduction from $9,326,000,000 at the beginning of 1921 to $7,271,000,000 at the middle of April, 1922. Since Jan. 1, 1922, the reduction has been relatively slight. This may be interpreted as meaning that compulsory liquidation of stocks of goods has been substantially completed. It does not mean, however, that stocks of goods have been reduced to the point from which a general replenishment will be required, but it may be assumed that of what remains the holding will be more comfortable, without there being banking pressure for further liquidation which would lead to renewed cutting of prices.

The coal strike, that has now been in progress for nearly two months, has caused but little industrial disturbance so far. Accumulated stocks of anthracite have not had to be drawn upon. Bituminous production in the non-union fields has increased to nearly 4,500,000 tons per week and this is estimated to be about 60 per cent. of present consumption. The deficit is supplied out of stocks, estimated at about 66,000,000 tons to begin with.

In many parts of the country there are strikes, which are increasing in number. A matter of concern to the metallurgical industry was a strike in the Perth Amboy district, which shut up two of the large copper refineries for a week. The progress of events is steadily confirming the forecast that 1922 would be a year of extensive and widespread labor troubles.

The U. S. Railroad Labor Board on May 11 delivered a decision that the contract, or "farming out" system of railway work, thus removing workmen from the board's jurisdiction, is illegal. This means that the railway companies must pay to unionized labor more than do other employers of the same kind of work if the Labor Board says so.

Just before the middle of May a surprise was sprung by the acquisition of Lackawanna by Bethlehem Steel company. This was followed June 1 by the announcement of a plan whereby the properties of the Midvale Steel and Ordnance Co., Republic Iron and Steel Co., and Inland Steel Co., will be unified under ownership of Midvale. The name of the new corporation probably will be the North American Steel Corporation.

Reports from South Africa indicate a gradual recovery from the recent strike in the Transvaal. Mining operations are restricted by a shortage of native labor. Recruiting is proceeding but it will take some months to restore the full complement of men.

An important event of May was the announcement that Utah, Ray, Chino, Nevada and Butte & Superior have compromised out of court the froth flotation patent litigation with Minerals Separation, and have become licensees. Settlement was based upon the principle of a reasonable license fee for use of Minerals Separation process without any penalties of any kind for past use and is retroactive, *i.e.*, these companies have agreed to pay the royalties that would have been due from them if they had taken out licenses in the first place, just as was done by Anaconda and many other companies. Thus ends the most spectacular, and perhaps the most costly, patent litigation in the annals of metallurgy.

The 10% freight rate reduction ordered by The Interstate Commerse Commission was accepted by the thirty-seven railroads of the Eastern Division. The new rate becomes effective July 1.

The United States Railroad Labor Board announced a reduction in railroad wages of about 13% effecting about 400,000 maintenance of way men also effective July 1.

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# The Teapot Oil Affair

By CHESTER W. WASHBURNE
Consulting Geologist, New York City

LEASING the Teapot dome to the Mammoth Oil Co. is the culminating anticlimax of the "conservation movement." It is just the touch required to make a full fiasco of the whole affair. If the revered wielder of the "Big Stick" were still with us, we could hear it fall harder than it did on Ballinger.

Of all the oil reserves set aside by presidential decree, there was only one which certainly could conserve much oil for the future. This was Naval Reserve No. 3, on the Teapot dome, Wyoming. After secret negotiations, carefully guarded from the press and from the knowledge of other oil men, we are suddenly informed that this last and only known chance to save much oil for future naval needs has been given away for early development.

### Drainage of Teapot Dome Limited

It is said that the Naval Reserve would be drained by wells drilled in the Salt Creek field, which occupies a larger neighboring dome immediatly north of Teapot. Such drainage may be admitted for only a very small percentage of the oil in the Second Wall Creek sand. In the First Wall Creek sand the two domes are separated completely by water. The Second Wall Creek sand, on the other hand, appears to carry oil down to or a little below the level of the sag separating the two domes. It is apparent, therefore, that complete drilling of the south end of the Salt Creek dome in the sag would in time drain some oil from the Second Wall Creek sand of the Teapot dome, unless, as Wegemann suspected, there may be faults across the sag which seal the Teapot dome.

The wells especially important in this connection are the wells of the Glenrock Oil Co. along the west line of Sec. 16, T. 39 N. R. 78 W. These are the lowest Second sand wells on the structure, except the Cosden well farther north. They all lie slightly below the level of the saddle or sag that separates Teapot. They all had water in the First Wall Creek sand and oil in the Second, but are only small wells, due to the eastward thinning of the sand. A recent completion by the Fensland Oil Co. in Section 20-39-78, only one-half mile southwest of the Glenrock wells, had 30 ft. of Second Wall Creek sand and is flowing between 500 and 1000 bbl. per day. This well lies about three-fourths of a mile northwest of the sag, and is not much higher structurally. It leads one to infer bigger wells than have been predicted in the Second sand of the Teapot dome.

From the elevation of the sand in these wells, it seems probable that the Second Wall Creek sand carries oil all the way across the saddle separating the Salt Creek dome from the Teapot dome. In that sand the two fields will have a narrow connection. The connection will be shallow, extending only slightly below the elevation of the saddle. The amount of oil that Salt Creek wells possibly could drain from the Teapot dome would be limited to a part of that lying below the lowest closing contour of the Teapot dome. It might possibly be as much as 10 per cent. of the total Teapot oil. When approximately this amount has been drained, the salt water in the Second sand will have risen to the level of the saddle, completely shutting Teapot from further drainage toward the north.

The thinning of the Second sand toward the east indicates that it is not likely to hold much oil on the lower east side of the Teapot dome. Only a little oil from the north end of the west flank is likely to be drained by Salt Creek wells. To save this drainage, roughly estimated at 10 per cent. of the total, the Secretary of the Interior has leased Teapot for immediate development. If the Teapot dome contains reserves of 30,000,000 bbl., as conservatively estimated by Wegemann, the Government is now to surrender this whole reserve for the avowed purpose of saving only the royalty on a possible 3,000,000 bbl., or say about 400,000 bbl., from going into private hands. Actually they are giving many millions of barrels to "private" hands, if that adjective can now be applied properly to the Standard Oil crowd.

### Teapot Only Real Reserve

One cannot blame Secretary Fall for lacking sympathy with the conservation movement. Every practical Westerner and Alaskan knows that the movement has cost his region in compound interest alone many times more than any possible benefit to the rest of the country. Protection from forest fires could have been secured by less stagnating methods. In the case of oil lands, the whole administration of the withdrawals has been a failure. It has conserved practically no oil for the future except in this Naval Reserve at Teapot; it has been merely a nuisance to the operators; it has been grossly unjust to locators of oil "placer claims" when they finally discovered oil on one claim only to have the Government slap a withdrawal order on all other claims. The operators circumvented the unfair withdrawals by costly litigation. The administration of the whole

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affair has been a practical failure, doing harm rather than good.

There was much greater justification for the Teapot oil reserve, which is one of the three parcels of probable oil land set aside to safeguard the future of the Navy against the time when oil supplies will become inadequate. That time remains far removed from the present, which is one of overproduction. In fact, I believe that for at least another generation the oil industry can supply the Navy with all the oil it needs in war or peace. After that the time is expected when the shortage of oil will be exceedingly serious. It may come sooner, but it will come long after the Mammoth Oil Co. has drained most of the oil from Teapot dome, if the present contract is allowed to stand. One may predict that with the increasing demand for crude oil, at least three-fourths of the total reserves of the Teapot dome will be exhausted in the next 10 years.

### Safety of Nation Threatened

If the lack of oil should contribute to our losing a war 20 or 50 years from now, with all the terrible consequences that would result, those responsible for giving away now our one last undrainable reserve will be linked in history with Aaron Burr.

Those who retarded the free natural development of the West with their ill-founded theory of conservation cared nothing for that important element of national wealth that arises from early industrial development. They never stopped to consider that the rings on a tree grow more slowly year by year while compound interest grows ever faster. Nor did they observe the rate of natural reforestation in western Oregon and Washington, where fire protection was the only thing needed. Nor did they stop to think that in tying up the great Western forests they were adding immensely to the value of private timber holdings and to the cost of lumber for home building throughout the country. Nor did they pause to observe that they were withdrawing enough coal land in the West to last the nation for centuries, and thereby merely adding to the value of private holdings and to the cost of coal. It never occurred to them that future generations might benefit more from a great early development of the West than it could from an idle hoarding of enormous areas, on the theory that the future might suffer from the lack of some commodity. Yet we must admit that the theorists who inflicted "conservation" on the country caused serious injury only to the Western states without greatly affecting the Eastern states, while the extremists of the other side now in office, who propose to drain the Navy's best safeguard long before the time of real need, are threatening the future safety of the whole nation.

The terms of the deal are fair and favorable to the Navy as a business proposition. It is not likely that any oil company could do more. The sliding-scale royalties are generous to the Navy. The Navy can accept either cash or an amount of refined products to be stored at convenient seaports which it selects. There seems to be a flaw in the rate of exchange of royalty crude for fuel oil which does not allow the Navy the full value of the royalties to be paid in fuel oil. The Navy, doubtless, will obviate this by accepting part cash and purchasing fuel oil on the market. Some day a deal of this kind would become desirable, but we trust and believe that black day of oil shortage is for a future generation.

The deal is purely a Standard Oil piece of business. If the Standard were not involved, the Midwest Refining Co., a subsidiary of the Standard of Indiana, would not have transferred to the Mammoth Oil Co. its "rights" acquired largely from the Franco-Wyoming Oil Co. to the early "placer" locations on Teapot dome, even though these locations are generally considered invalid. The Mammoth is said to have used these "rights" as giving a sort of priority over other claimants to a lease on Teapot. Of course, if they had been considered valid, the Midwest would have drilled Teapot long ago. Having the dome drilled by a company affiliated with the Standard, such as the Mammoth appears to be, practically assures the construction of the pipe line to connect with the Chicago and sea-board terminals. If the Teapot dome should not produce enough oil, placed in the contract at 20,000 bbl. per day, to justify building the $20,000,000 pipe line, the required oil can be obtained from Standard interests in the Salt Creek field. The latter is capable of doubling its present output of nearly 50,000 bbl. per day, all of which is now refined locally, mostly at Casper and Glenrock. There is an economic loss in the present development of Wyoming refining capacity beyond local needs, which requires expensive rail shipments to distant markets. A large part of the Casper gasoline output is now being shipped in tank cars to Gulf ports for export.

### Independent Operators Fighting Lease

Independent operators, led by the Rocky Mountain Oil and Gas Producers Assn., are fighting the lease. They are ably assisted by Governor Carey of Wyoming and by the Wyoming Senators and Congressmen in Washington. They say that since the present outlet accommodates only 40 per cent. of the potential production of the present wells in Salt Creek, the drilling of Teapot will cause only further local over supply and congestion. Even at the distant time, probably several years ahead, when the proposed Mammoth line is built to the East, there is not likely to be adequate relief for them. The line will transport probably only 15,000 to 20,000 bbl. per day, which is only a small part of the excess of oil now "pinched" at Salt Creek alone. Moreover, drilling is becoming more active in Salt Creek.

They object to this contract, also, because it tightens the stranglehold of the Standard on Wyoming, which

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it already controls more closely than any other oil region. If the contract had been given to a company that did not fear to reveal its financial composition and relations, which the independents know is only a scheme to hide its Standard affiliations, they would feel more confident that the new pipe line would create actual competition with the Midwest (Standard). The Mammoth, being considered only a Standard-Sinclair affair, is not expected to result in any real competition. The independents would expect better market conditions if the Gulf or Texas companies had been given the contract, though no one knows whether either of the latter would accept it. They say the Government is giving the small Wyoming producer a raw deal in making the contract with a company that will keep him always under the heel of the Standard.

The fair-play spirit of the Westerners is incensed further by the way in which the whole business was conducted behind closed doors as though it had been a naval secret. They would like to know what the Texas Co., the Gulf Oil Corpn., and other strong independents would have done. They could have clubbed together to handle the business themselves. Open discussion and bidding has been the rule heretofore in granting leases on Indian lands, to the great benefit of the Indian. Similar bidding might have been to the advantage of the Navy.

Many doubt the legality of granting a lease on the undrainable part of the Teapot reserve during the present period of overproduction of oil. Since the Naval Reserves were created to conserve oil underground until the time of need, it is contrary to the purpose of the law to release that oil at present, even though the latter law of 1920 placed the matter under the discretion of the President and the Secretary of the Interior. They believe that the President would have been better informed had the matter been discussed freely by the oil fraternity instead of behind closed doors by a chosen few.

### Summary

The essence of the matter is this: Secretary Fall has made a good bargain for the Navy to secure oil reasonably and conveniently for a few years. In doing so, he has deprived the Navy of its only certain oil reserve for the distant future, when it may be much harder to obtain. He has overlooked, therefore, the essential purpose of the Naval Reserves.

The checkerboarded condition of the two Naval Reserves in California makes them useless as reserves, because the owners of alternate deeded sections can drain much oil from the Government land. In those places, efficient reserves could have been created only by commandeering and buying the private holdings. Failure to do this renders the California reserves useless for their intended purpose. There is no apparent reason why they should not be leased now to the highest bidder, as a mere commercial transaction.

Conditions are quite different in Naval Reserve No. 3, or the Teapot dome. There only a negligible percentage of the oil could be drained. The action of the Secretary of the Interior in this case saves the Government its royalty interest, say some 400,000 bbl. worth, say $600,000 in the 10 per cent. of the total oil that might be drained by legitimate private wells. This saving is negligible and even if it were a hundred times that sum, it would be wrong, because it was not the purpose of the Naval Reserves to make oil a little cheaper for the Navy in times of plentiful oil, but to provide against the distant day when the supply of oil will become wholly inadequate.

Secretary Fall has destroyed the only safe future reserve of oil the Navy possesses, in order to save the Government a little royalty on the negligible percentage of the Teapot Reserve that could be drained by private wells. His object is to guard the immediate profits of the Government and ignores the real purpose of the Reserve to hold oil for the distant time of real need. His object might better have been obtained by granting, through competitive bidding, permits to drill offset wells along the short drainable northern boundary of the reserve. This would have safeguarded all of the oil in the Shannon and in the First Wall Creek sands of Teapot and would have drained but little more oil from the Second Wall Creek sand. Instead of this he has given a heritage for a mess of pottage.

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## Federated Renews Campaign for Department of Public Works

WITH the warning that President Harding is encountering opposition so strong that his efforts at Government reorganization may be defeated "as were the efforts of Roosevelt and Taft," the American Engineering Council of the Federated American Engineering Societies announced that the engineers of the nation would start afresh a nationwide movement for the establishment of a National Department of Public Works.

The statement of the Council is, in part, as follows:

The President of the United States is endeavoring to formulate a program for reorganization of Federal functions according to the precepts that govern the efficient conduct of private business. He is following the principles originally adopted in the movement of the technical men of the country to secure a Federal Department of Public Works.

The President's course was easy until he began to specify the changes that should take place in the Government to conform to these cardinal principles. He is now encountering opposition so strong and well supported that it is feared his efforts may be defeated even as were the efforts of former Presidents Roosevelt and Taft along the same line. The President, therefore, is in need of the friendly assistance of those who have no prejudices, no self-seeking and no special purposes to serve.

The country needs the voices of those who look and think beyond the outer skin. We always have with us the voice of the crowd, too often impelled by unwise leadership and mob psychology. Every little while it is incumbent upon the thinking portion of our citizenship to render public service.

Engineers started many years ago to urge the creation of a National Department of Public Works. Their sole reason was that the country needed, and still needs, the orderly functioning of its public works activities—needs it because our present system

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involves a huge waste of public funds, high taxes, and retarded public improvements. The principle is self-evident and if the proposed reform were merely an abstract principle there would be no one to dispute its merit. It would have succeeded long ago if it did not interfere with certain official, political and personal interests.

The President himself has set up the slogan, 'more business in government, less government in business,' and there is no reason why the public business should not be conducted with the same efficiency as a modern private business is. The reason why it is not so conducted is that the millions who understand the underlying principles and who recognize the merits have not insisted that it should be done.

As a result of the public works department movement the Government reorganization idea became a plank in the platform of the political party at present in power. Congress created a committee to reorganize Government business. The Federated American Engineering Societies has become officially concerned with the creation of a Department of Public Works. It is apparent that the object can never be achieved unless the broader object is carried through successfully; therefore this organization, as well as all others that believe in efficient procedure and that know and understand the underlying principles, must participate in the entire program of Government reorganization.

Dean Mortimer E. Cooley, of the University of Michigan, president of the Council, recently visited President Harding, to whom he tendered the support of the organized engineers of the nation in matters affecting engineering and allied service.

## Compulsory Working of Patents

AT THE hearing on the Stanley Patents Bill S-3410 on May 1, Emil Gathmann represented the Institute. The Stanley Bill amends the patent law to authorize the granting of compulsory licenses if patents are not worked to an extent and within a time to be determined in each individual case by the Commissioner of Patents.

Edwin J. Prindle, chairman of the Patents Committee of the Federated American Engineering Societies, made a very able presentation of the issues involved, and clearly indicated the danger not only to the inventor, but to industry as a whole, inherent in such revolutionary legislation. Colonel McMullen, of the U. S. Army's patent branch, was heard in favor of the bill, and gave a clear statement of the necessity which he believes exists to compel foreign citizens holding U. S. patents to work, or allow of the working of, said patents.

Undoubtedly, the Senate Committee will not report the Stanley Bill until there has been opportunity for further discussion and consideration by those interested in the measure, but even if this bill is killed, the substitutes that will probably be proposed will also need careful consideration.

## International Mineral and Metal Statistics

THE International Chamber of Commerce, through its committee on statistics, wishes to secure from business men statements of their requirements for statistics of international trade and production. The Bureau of Foreign and Domestic Commerce desires to aid this committee and therefore wishes to enlist the help of the coöperative committees of trade associations and individuals in securing this information for their particular industries. The purpose of this inquiry is to obtain information that will guide in the improvement of present facilities, both as to the kind of statistics needed and the form in which they are published.

The Bureau of Foreign and Domestic Commerce, Fuel Division, Washington, D. C., will be glad to receive from producers and consumers of ores and metals information on the following points:

1. To what extent does your industry find international statistics of trade and production inadequate for present needs?
2. Do you now make use of any of the sources of international trade statistics? If so, in what respect are these insufficient as to content or as to form? What features are of most value to you?
3. Have you any suggestions to make as to the kind of international statistics that are needed for the various mineral and metal industries, and the form in which those should be issued?

## International Engineering Congress

BRAZIL will celebrate the hundredth anniversary of her independence in September, 1922, in an international exposition at Rio de Janeiro. In connection with the exposition, an international engineering congress will be held, to which the engineers of the United States are cordially invited.

Word has been received, through the Brazilian Commercial Attaché at Washington, that the Brazilian Government approves the International Congress of Engineering at Rio de Janeiro for next September, and that steps have been taken towards all necessary preparations.

The program of the Congress will include discussions on: The utilization of fuel resources; the best utilization of water power; recent advances in irrigation methods; the elimination of waste through the standardization of supplies for agricultural and industrial purposes; coal as a factor in industrial development; essentials of a national railroad policy; intercontinental engineering coöperation; port developments; terminal facilities; the iron and steel industry.

Representatives from American engineering societies will receive credentials from their respective societies.

Mining engineers who expect to be in Brazil during the time of the exposition are urged to notify the secretary of the Institute, so that they may be provided with all necessary credentials and information.

The Secretary of the Interior has designated Thomas T. Read, chief of the Information Service of the Bureau of Mines, as the representative of the Interior Department on the executive committee which is to coöperate with the Commissioner General, Col. D. C. Collier, in making arrangements for a suitable exposition of the activities of the Government of the United States.

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# Bituminous Strike Situation

By EDWIN LUDLOW

Consulting Engineer, New York City

ONE of the most unusual features in connection with the strike of the union coal miners in the bituminous fields, now in its sixth week, is that the public interest seems to have completely died out. There is nothing on the front page and very little on any other page of the daily newspapers in connection with the strike. The United Mine Workers' officials must be rather disappointed to find that the only way in which they are being featured in the papers at present is in the reports of the trial for treason that is going on in Charlestown, West Va., against the local leaders of that organization for their responsibility in connection with the attack of the miners' army last summer against the non-union mines of Logan and Mingo Counties.

Recent reports state that there are 13,000 cars of coal standing on the sidings at union mines for which no billing has yet been found. The output of the non-union mines has been gradually increasing but has never reached the maximum that they are capable of producing, owing to their inability to obtain enough orders to make it possible to run full operating time. The present output is estimated at 4,500,000 tons a week. It is possible, with a full car supply and full demand, to bring this output up to approximately 6,000,000 tons per week, and it is very doubtful whether, at this season of the year when probably there is less consumption of coal than at any other season, the requirements of the country are greater than the 6,000,000 tons which the non-union mines are capable of producing. It would appear, therefore, that there is no immediate prospect of any settlement of the bituminous strike, and there is certainly no reason why the operators of the union mines should show any anxiety to begin operations as long as they have unbilled coal standing on their sidings.

## Overdevelopment of Coal Mining

A great deal has been written in the technical and daily press in regard to the overdevelopment of the bituminous coal fields in this country. It seems a little peculiar that the coal industry should be the subject of such sharp criticism in this regard, when conditions in coal mines during the last year have been the same as in other mining industries of the country. Nothing is said about the overproduction of copper, although the large producing copper mines of this country have been absolutely closed down for a year and only now are beginning to resume operations. The same is true to a large extent of the iron region, as the papers are speaking of the opening of iron mines in Michigan at which work has been suspended for over a year. If the large producing coal mines, when the business depression occurred a little more than a year ago, had followed the example of the copper mines, and closed down, there would have been no overproduction of coal.

A great deal has been written also in regard to the seasonal nature of coal mining. This is true, but the work of the farmer is equally seasonal; the glass manufacturers of this country work, on an average, only six months in the year; and yet the coal mine is singled out as functioning so badly because it is not able to sell coal when people do not want to buy that commodity.

## Surplus of Labor and Wagon Mines

With regard to the overmanning of the mines and the possibility of producing the required amount of coal with less labor, and the sufferings of the miners from the three-day week that the mines have been able to average, it must be remembered that the excess of labor is due to the high wages paid the coal miners. Under the union scale, a day laborer receives $7.50 a day; in any other vocation the same unskilled laborer would not be able to earn more than $3. He is better off, therefore, working three days a week at $7.50 than six days a week at $3. As for the contract miner who is able to earn $10 to $20 a day without working even the eight hours, he would certainly have great difficulty in finding any other class of work that would bring him in the same weekly wage, even if he were working full time. The 100,000 men which it is estimated might be taken from the coal industry and put into other lines of employment might possibly be found, if they were able to earn in those other employments as much money as they are now able to obtain even with the short time the mines are in operation.

Another feature in the bituminous industry that has not been taken into account is the "wagon mine." These small operations are usually worked in partnership by miners who are not able to obtain a sufficient output to warrant the building of a tipple and the necessary railroad sidings but who haul the coal in wagons from their drift and slope openings to the nearest railroad station. These mines might be considered "snow birds," coming out in force during times of high prices. The additional expense of the wagon

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haul makes it necessary for them to obtain about a dollar a ton more than the operator of a large mine is willing to accept. The possible tonnage from these wagon mines, of which there were 7000 at one time at work, would run in the neighborhood of 100,000 tons per day. If the strike continues and the price of coal advances, these wagon mines will undoubtedly spring up in practically all sections of the mining field.

### Ten-year Increases in Bituminous Coal Output

In the year 1880, the output from the United States was 51,200,000 tons; in 1890, it was 120,000,000 tons, an increase of 150 per cent. for the 10-year period. In 1900, the output was 200,000,000, an increase of 66 per cent. for the 10 years. In 1910, the output was 390,000,000, an increase of 95 per cent. and in 1920 the tonnage had reached to 575,000,000 tons, an increase of 48 per cent. The average shows that the output of coal doubles every 10 years. The last 10-year period, however, would indicate a slowing down, due to the greater use of fuel oil and electricity, but, according to the law of averages and the continual growth of this country, we should find that with the revival of industry, our annual output should reach to 750,000,000 tons, and when it does, the output will have caught up with the mine development of the present day.

The present so-called overdevelopment is the greatest protection to the industries of this country in ensuring to them a continual competition in the price of bituminous coal that will always enable them to obtain their fuel at a minimum cost commensurate with the wages that the miners are paid.

As to seasonal fluctuations, a great deal of this could be eliminated if the largest steam users—manufacturers, public utilities and especially the railroads—would make contracts for the fuel based on receiving 50 per cent. of their annual requirements during the four dull months of the year and the other 50 per cent. during the other eight months. The cost of storing the surplus coal received during the four months would be absorbed by the operator in making his price, either by a reduction in the yearly price, or by an allowance on the price for the surplus stocked. The greatest advantage would accrue to the railroads, which would thus increase the available car supply during the winter months, and enable the operator to have a tonnage to meet the seasonal demand of the winter and, at the same time, maintain a continuous output.

### Long-term Contracts Needed

It would be of the greatest possible assistance, also, in the stabilization of the industry if coal contracts could be made for a term of five to ten years. The present short-term contracts reaching from year to year, offer no security for the development of a property. When the contract comes up to be bid upon, it may go to some other mine, which has been able to see its way clear to reduce the price a few cents a ton. A mine that loses a large contract cannot afford to close down and abandon its investment, but will struggle along as best it can hoping that the next year it may secure the contract again. It becomes a continual temptation, in a country that is still so rich in undeveloped resources as this, for operators to open new mines adjoining the old ones, knowing that their costs in the early years will probably be less than those of their neighbors, on account of the greater expense for maintenance of the older and larger workings. This would be eliminated to a great extent if the railroads and larger users would make long-term contracts, as capital would be very slow to invest in a new operation if the tonnage normally mined in that section were contracted for, making an additional market problematical.

### Mr. Hoover's Conference with the Non-union Operators

The commanding feature in the bituminous situation was the meeting in Washington on May 18, called by Mr. Hoover, of the operators of the mines in West Virginia and Pennsylvania which are still producing coal. The decreasing stocks and the increasing demand for coal throughout the country had been reflected in slight increases of the price at the mines and large increases were reported by some consumers who bought their coal through brokers.

Mr. Hoover's plan of bringing together the operators in the open-shop mines is an extremely valuable one, if some legal means can be found by which a combination can be made not only for the protection of the public during times of coal scarcity but for the protection of the mines themselves from unfair competition and the reduction of prices below the cost of production. Unquestionably, there will be a shortage of coal as time goes on, and the great pity is that this could not have been anticipated early in April so as to have allowed the open-shop mines to produce a maximum tonnage.

It would be of advantage to the country if coal could be purchased by the consumer from the producer, instead of passing through three or four hands, each of which takes a heavy toll in additional price, as was the case during the coal shortage of 1920. The price paid should be high enough to stimulate increased operation of some of the high-cost mines in the non-union fields but should not be so high as to warrant any of the union fields in renewing their contracts with the miners on the basis of the exorbitantly high wage which the miners are asking. Every effort should be made by both the Government and the railroads to stimulate the output of the open-shop mines, as upon their ability to prevent a coal famine in this country depends the question as to whether this country can be dominated by union leaders exacting an inordinate wage in their own specialized industry.

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# The Anthracite Situation

By R. V. NORRIS

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THE wage rates and working conditions in the anthracite region of Pennsylvania have been governed for nearly 20 years by the award of the Anthracite Coal Strike Commission, appointed Oct. 16, 1902, by President Roosevelt. The report of this commission, made in March, 1903, was accepted and, with eight modifications made at various dates, has had almost the force of law, and has kept this great industrial region free from strikes for almost a generation. In 1920, President Wilson appointed an Anthracite Coal Commission, and its report, accepted Aug. 30, 1920, governed wage conditions to April 1, 1922.

Actually, the agreements have been for terms of two to four years, and lately, in 1916 and 1920, the employees have continued at work pending the negotiation of new agreements which were made retroactive, and which have all been modifications of the original 1903 award. With the expiration, April 1, 1922, of the 1920 award approaching, Mr. Lewis, president of the United Mine Workers of America, addressed a letter, on Feb. 20, to the operators, suggesting a meeting on March 15; this date was accepted by the latter, with the notation that the time was short. At the meeting, the Mine Workers presented 19 demands, and advised that if a satisfactory agreement was not reached by April 1 a suspension of mining would occur, contrary to the practice since 1916 of continuing work with a retroactive adjustment.

## Demands of the Mine Workers

The demands were made up of the substance of all those refused by the 1920 commission, coupled with a demand for 20 per cent. increase in contract rates and $1 per day for labor. The granting of all of those, which included many costly jokers, it is estimated by the operators would add $170,000,000 to the annual cost, which, necessarily borne by 53,000,000 tons of domestic sizes, would add about $3 per ton to the cost of coal at the mine.

The demands further include a "standard check-off provision," which has never been included in any anthracite wage agreement, and which was peremptorily refused by both the Roosevelt and Wilson commissions; a demand for a day of eight hours underground, instead of at the working place, really a six-hour day; seniority employment, and lastly "an eight-hour opportunity" to employees or readjustment wages for shorter days—in other words, eight hours pay per day whether worked or not.

These demands have now been discussed for over two months without result, other than to develop a "red herring" in a proposal from the Mine Workers for a commission to investigate conditions, including railroad charges, retail profits, etc., which are not under the control of the operators, coupled with a most unfair preamble practically prejudging the case. The proposal of the operators for a long-term contract, with an arbitration board to adjust wages at intervals, was refused as interfering with collective bargaining.

Finally, the operators have made a counter offer of 18 per cent. reduction in contract rates and $1.20 per day for men and 72 cents for boys on day rates, stated to average 21 per cent. reduction, and to bring the miners' pay down from the 1920 award in proportion to the decrease in cost of living since that time. This it is reported was refused point blank by the miners' vice-president.

## Earnings of Anthracite Workers

The earnings of the anthracite mine workers were exhaustively investigated by the National Industrial Conference Board in a report issued March 20, based on 179 collieries with 91 per cent. of the 1920 anthracite output. The Board finds:

| | Jan., 1914 Cents per Hour | Oct., 1921 Cents per Hour | Increase Per Cent. |
|---|---|---|---|
| All wage earners... | 27.8 | 72.8 | 162 |
| Excluding contract miners..... | 22.5 | 59.9 | 166 |
| | Dollars | Dollars | |
| All wage earners, semi monthly.... | 29.81 | 75.18 | 152 |

The percentage increase for industrial workers, July, 1914, to July, 1921, was 113 per cent.; for railroad workers to October, 1921, 131 per cent., compared with 166 per cent. for anthracite mine workers; the weekly earnings in manufacturing industries, 83 per cent., and for railroads 102 per cent., compared with 152 per cent.

The average hours in the half month were: June, 1914, 107.4; October, 1921, 103.3; with 100 hr. as full eight-hour time, the work has been regular and full as is shown by the great prosperity of the region. The bank deposits in the region have increased from 241 million dollars Jan. 1, 1920, to nearly 322 million, Jan. 1, 1922, an increase of one-third on the total, which does not indicate underpayment.

It is clear that the coal industry could not stand the increased cost that would be involved in even a

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partial granting of these demands, and the mine workers make no secret of their intention to try and nationalize the industry and then permit the excessive wages to be paid out of the national treasury without increasing the price of coal to the consumer.

The question at issue is: Shall the coal production costs be deflated in line with the business of the country, or shall the price of this necessity be maintained on a pinnacle of cost to permit of the continuance of 17 per cent. more than war wages to one privileged class, the members of the United Mine Workers of America?

## Will the Institute Coöperate with the Department of Commerce?

THE Secretary of Commerce, Herbert Hoover, has addressed a letter to the American Engineering Standards Committee, in which he says:

> There is a steadily increasing interest on the part of leaders of our industries in the great economies that are possible through the simplification of lines of manufactured products. . . . A vast deal of work is going to be required to select and delimit specific problems in form for work. . Will the American Engineering Standards Committee undertake a canvass of the engineering and technical bodies that are coöperating in its work, so as to determine what simplification in manufactured products in their fields is most needed and most desirable?

The Institute's representative on the A. E. S. C., George C. Stone, in transmitting Mr. Hoover's letter to the Board of Directors, asks for the coöperation of Institute members. Please send your suggestions or comments on constructive simplification in your field to the Secretary of the Institute, so that this preliminary survey may be of real assistance to the Department of Commerce in its work.

## Coöperation in Exploration

By F. F. Sharpless

WE ARE publishing herewith a page from a recent work of Dr. C. K. Leith, "Economic Aspects of Geology." We believe that it is of particular significance to the members of the Institute because they possess the opportunity to practice what he preaches. The chief reason for the organization of the Institute was that its members might be "able to exchange technical information." The rapid strides that have been made in this country in mining and metallurgy have been largely due to the fruition of the conception. The members of the Institute have for years exchanged technical information most freely. Doctor Leith says:

> Competition in exploration often develops an atmosphere of suspicion and furtiveness which is highly unfavorable to coöperative efforts. Individuals and companies may handicap themselves greatly by a desire to play a lone hand, and by failure to take advantage of an exchange of information. This action may be based particularly, on the part of strong mining companies, on the assumption that they know all that is necessary about the problem, and that an outsider has nothing to contribute. Financial and other conditions may require this attitude, but in large part it is a result of temperament, as clearly indicated by the difference in methods followed by different groups and in different mining districts. From the scientific point of view this attitude can hardly be justified, in view of the extremely narrow limits of human knowledge as compared with the scientific field to be explored. The sum total of knowledge from all sources is only a small fraction of that necessary for the most effective results. The mutual exchange of information and discussion is usually justified on the basis of self-interest alone, to say nothing of the larger interest to the mineral district, to the country, or to science.
>
> National and state survey organizations exercise considerable effort to secure records of drilling. In some cases they have the legal power to command this information, particularly in relation to appraisals for taxation and "blue sky" laws. In a larger number of cases drill records are secured through voluntary coöperation with explorers. A considerable number of records are nevertheless not filed with public agencies and some of these are permanently lost. Even where the records are turned in to a public organization, they are in most cases not directly available to explorers.
>
> Public registration of all drilling records is a highly desirable procedure in the interests of the development of the mineral industry as a whole. A vast amount of unnecessary duplication can thus be avoided. The record of a drill hole, even though barren, may be of vast significance in the interpretation of future developments and should be recorded as carefully as an abstract of land title. The property right of the explorer in such information can be and usually is protected by withholding the record from public inspection until sufficient time has elapsed to give him full opportunity to use the information to his own best advantage.
>
> The opportunities for coöperation with specialists of public organizations are almost unlimited. These organizations are likely to have an accumulation of data and experience extending through long periods and over large areas, which the private explorer ordinarily cannot hope to duplicate. With proper restrictions, this information may be available for public use. A good illustration of current coöperative effort of this kind is in the deep exploration for oil in the Trenton limestone of Illinois. Outcrops and other specific indications are not sufficient to localize this drilling; but the information along broad geologic and structural lines which has been collected previously by the Illinois Survey is sufficient so that, with a comparatively small amount of shallow drilling, the locus of the more favorable structural conditions may be determined. In this case the Survey is directing the initial exploration, which is financed by private capital.

The oil geologists of Oklahoma are freely exchanging the results of their exploration work. All of the major operating companies in that state possess underground geological maps that are marvels of accuracy, only attainable through the close coöperation of those who have secured the data by drilling.

What the metal miner could and should do is exemplified in what Dr. James Douglas did in respect to his work in the Copper Mine River district in northern Canada.

The writer was once urged to drill a tract of land in the Joplin zinc field. The tract was located on what appeared to be a well defined channel, the ground both to the north and south having been productive. Careful inquiry disclosed the fact that it had already been drilled three times with negative or poor results. Each party had drilled without knowing what the other had found. This was an economic crime. Three times the acreage might have been drilled if the operators had been willing to make their results public, with three times the chance of finding something worth while. We urge upon Institute members the practice of asking freely and of giving freely. It is ethical, and it is profitable.

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# Foreign Oil Possibilities and Domestic Price Fixing*

By RALPH ARNOLD

Chairman, A. I. M. E. Petroleum and Gas Committee

IN OPENING the symposium under the auspices of the Petroleum and Gas Committee of the American Institute of Mining and Metallurgical Engineers, I wish to call to your attention the following, among other subjects, which it is hoped may receive proper attention:

1. The recording of as accurate an appraisal of the oil possibilities of the various countries as is possible, with information as to the immediate availability of their supply.

2. The development of further support for the movement to bring about active coöperation among American oil companies in their foreign exploration and development work.

3. The furtherance of the efforts of the industry in securing governmental assistance in foreign oil development: (a) along the lines of a modification of our domestic oil policy, so that we can go to foreign countries and consistently ask fair treatment as to royalties and bonuses; (b) by a closer coöperation between the State and Commerce Departments and the oil industry.

4. The calling of attention to the unjustifiably drastic action of the price-fixing group of the oil industry during the last year or so, with the hope that it will use gentler methods in the future.

None of these subjects are new, and some of them have been discussed before various organizations for years. Our justification for again bringing them forward is the hope that by everlastingly harping on them the industry, the Government, and the people who shape the destinies of this country may some time, some how, realize their importance and take effective constructive action.

It is a source of great satisfaction to many of us that, after a campaign of several years' duration on the part of a group of economic geologists and engineers, the American oil industry has been awakened to a realization that the crude-oil resources of the United States are not inexhaustible; that our crude oil should not be wasted but should be conserved, and used only for those purposes for which it alone is adapted; that every energy should be bent to improve our methods of refining, so that greater and greater percentages of gasoline, lubricants and other more desirable and valuable compounds may be made from the crude oil, rather than dissipated as fuel; and that, as some of the most conservative of the operators have even admitted, there is a possibility in the dim distant future that we may have to resort to our oil shales as a source of supply. No less a person than Thomas O'Donnell said most of these things in public at the recent sessions of the American Petroleum Institute in Chicago, and H. F. Sinclair at the same meeting admitted that we need a foreign supply and just wondered if the industry was willing to pay the price necessary to get it. It is, therefore, no longer *lèse majesté* in oildom to warn of our waning resources and call attention to the need of a foreign supply. Both the scientist and the practical oil man reach exactly the same conclusion and say exactly the same things on the subject—except that the scientist says it about seven years in advance of the operator.

## Coöperation of Government Needed

The second item of discussion, namely, the furtherance of the movement to bring about active coöperation among American companies operating in foreign fields, will probably take the form of suggestions, oft repeated in the past, but brought more forcibly to the companies themselves by the recent débâcle in Mexico, the direct result of cut-throat competition between American companies in that field. Favorable action along these lines of coöperation is now a reality in at least one case.

One of the principal handicaps under which Americans operate in negotiating for oil concessions and leases in foreign countries is the excessive bonuses and royalties exacted by our Government from operators on Government and Indian lands. It is true that in most instances the extremely high bonuses of thousands of dollars per acre, and the excessive royalties amounting to as high as 55 per cent. of the gross production, relate to leases on land proved to be highly productive; but foreigners are not prone to differentiate between proved and prospective land, and hence use these high figures as arguments in favor of impossible terms and conditions in their own cases. I should like to venture the guess that in most instances where these excessive

*Opening address at Symposium on Foreign Oil Possibilities, Feb. 21, 1922.

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bonuses and royalties are paid, only a trifling profit, if any, is made by the operator. It was my good fortune to help prepare the first draft of the leasing bill, several years before such a bill finally became law, and in these early drafts no effort was made to reserve the lion's share of the profit to the Government, as in the present law. In order to bring this question to a head with Congress, I would suggest a modification of the present law so as to make the maxium royalty 10 per cent., and abolish any but nominal bonuses. The hazards of the oil business are great enough without the Government "taking the last pound of flesh," and the benefit that would accrue to our nationals in foreign fields by reason of reduced royalties and bonuses at home would far outweigh the immediate loss to the Government through the adoption of such a policy.

Coöperation between the State and Commerce Departments is closer than it has been at any time during the past, thanks to the men at the head of these two departments. There is still much to accomplish along the lines of settling matters of contention between domestic companies before they enter the foreign fields, so that whenever American companies go abroad they will do so with a solid front to the men with whom they are to deal. A strengthening of our consular agency and commercial attaché systems would do much to help our foreign oil activities. Information regarding possibilities in new countries or the activities of foreign business rivals in any field is most valuable in advancing our own interests in these countries.

### Power and Responsibility of Price-fixing Group Tremendous

Walter Teagle has endeavored to show by statistics that the foreign imports of oil (meaning Mexican oil) have little effect on the price of our light domestic crude. Mr. Teagle's case is greatly weakened by the fact that the price fixers knocked 70 per cent. from the price of Mid-Continent crude when the great glut of Mexican oil loomed last winter as a menace to our domestic industry but began raising the price again as soon as it dawned on the fixers that most of the proved Mexican fields were doomed to speedy exhaustion. This erratic manipulation of the price caused the ruination of many small operators and independents with a corresponding advantage to the stronger oil companies. In other words, many of our American independent operators and companies were sacrificed on the altar erected by the few producers and importers of Mexican oil. Let us take the most charitable view of the case and assume that the price manipulation was done as a result of panic rather than premeditation.

In order to prevent a repetition of this catastrophe, Congress should bestow upon the President the power to impose a sufficient import duty on oil to protect the domestic industry from disaster when foreign importations appear menacing. By this, I am not suggesting an import duty on oil to harass those companies who are far-seeing and courageous enough to enter the foreign fields, but rather to prevent the dumping which has caused most of our troubles during the last few months. Arguments of the exponents of cheap oil and cheap gasoline may be anticipated by saying that anything, such as these drastic cuts in price, which tends to unstabilize the industry later only assures a higher price to the consumer and a small profit or actual loss to the producer.

The power wielded by the group of men who fix the price of crude oil in this country is tremendous. I think I am disclosing no secrets of the oil fraternity when I say that they sometimes become the "inexorable law of supply and demand" when it suits their purpose. There is also a great responsibility to the rank and file of the producers and consumers and to the general public, if you please, which goes with this power. I, for one, am glad that this power rests in the hands of responsible and tried business men familiar with the vicissitudes as well as with the joys of their industry, rather than in the hands of irresponsible and inexperienced theorists. As long as these business men use this power with justice and discretion nothing should be done to interfere with them, but when they force through as unjustifiably drastic a cut in the price of crude oil as was done last winter steps should be taken to curb their ability to wreak havoc on the industry. I would not place the responsibility for all of our price depressions on this price-fixing group, by any means. Often the producers, large and small, are to blame because of their refusal to adopt programs curbing drilling activities. Furthermore, our present lease system, with its off-set well requirements and compulsory drilling clauses, is a curse to the sane development of many fields. I do want to suggest, however, to the price-fixing group of our industry, in the most friendly way, that they cease using "caveman tactics" and use more discretion, conservatism and magnanimity in regulating the price of crude oil so that they may have the confidence of the industry, the Government and the people. Geologists and engineers through scientific study have become the great factors of conservation in the finding and development of the oil fields; why not apply some of their methods to the price-fixing end of the business?

Again referring to Mexico, may we not say that the oil industry there is "between the devil and the deep blue sea"—meaning, of course, the tax problems on one side and salt water on the other. Only three companies are left in the mad race to empty the last of the important magic pools of the proved light oil field of Mexico. With only 24 wild-cat wells going down outside the proved belt of Mexico in the search for new fields, and none of these at all certain of getting important results, what are we to expect of Mexico in the next few months? When will the crash come and what will be the extent of the damage?

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# The Technical Audit

By ALLEN H. ROGERS
Consulting Engineer, New York City

IT IS universal practice for corporations, at the end of the fiscal period, to call in a firm of chartered accountants to audit the books. The effect of this is to put an independent organization's seal of approval on the accounting of the business done by the management. Their report lets the stockholders know that the accounts rendered truly present the results of the year's business. This is as it should be; the average stockholder has no personal contact or even acquaintance with the managers of his enterprise and the approval of their stewardship by an independent agent is very desirable for maintaining confidence in their honesty and ability.

But such an examination deals only with what may be called the arithmetic of the business; even the most elaborate audit, as the practice is at present, goes no further than to verify the items of the inventory. In other words, while checking up the entries showing the transactions of the year and certifying to the correctness of the items of the balance sheet, such a report gives the stockholder no idea of the ability with which his affairs have been managed. If the profit and loss balance is satisfactory, as certified by the public accountants, he assumes that the management has been able; where it is not, he turns to the president's report and usually finds an explanation. Such an explanation never takes the form of admission of mistakes in business judgment or of bad technical management. It could hardly be expected that it would.

The stockholder is generally furnished, therefore, with a certificate of the honesty of his management, but never one of its ability. He does not worry about the latter as long as dividends come in; when they cease, his action generally finds expression in replacing the management. In other words, so long as profits are realized, he assumes the management to be good, even though its success is a matter beyond its control and better management would make larger profits. When there is no profit, the stockholders have no means of knowing whether it is due to conditions beyond the control of the management, as the annual report is sure to allege, or whether, by better management, profit is possible. Here is where the technical audit comes in.

A technical audit is an examination of the operations of the corporation made by an engineer skilled in the particular industry in which the corporation is engaged, with a view to determining the efficiency with which they are being conducted by the management. The report of such an examination furnishes to the stockholders an account of the ability, greater or less, with which the affairs of their corporation are being handled. It furnishes a much more comprehensive view of the results of operations than the financial audit. It shows how the financial results have been attained, how these fall short of possibilities, and in such case how the ultimate possibilities can be attained. Such examinations, made at intervals, do more to keep the management on its toes than anything so far devised. It is what the consulting engineer of a company is supposed to do, and there is no gainsaying the fact that in most cases such an officer aids materially in keeping the local manager keyed up to his best, but the intimacy which sometimes develops between the manager and consulting engineer militates against the best results. As is well known, the management of long standing is apt to get into a rut; old practices are followed because of conservatism or, perhaps, of the labor involved in adopting more modern and economical ones; "they are not adapted to our conditions, anyway" is often alleged as a reason for not adopting methods characterized as "new-fangled." Old employees gradually shuffle off much of their work on to younger men, retaining jobs that become sinecures. It would be amazing, were it not well known, to state how often an employee is kept on because of some personal knowledge, supposed to be vital, which he has acquired through long employment. "He is more familiar with that mine than anybody living" is said of more than one foreman, when possibly all of his work is being done by some subordinate.

With the march of science, technical processes are constantly being improved and new ones, cheaper and more efficient than the old, are being constantly devised. The manager frequently has little time for technical reading and certainly very much less for observation of new processes and apparatus in operation at other plants. It is not altogether his fault, therefore, that he is not up with the procession. Further, he is a rare man who can regard all his employees impersonally, so impersonally as to judge coolly, in terms of dollars and cents, the work they are doing and the results they are achieving. Finally, from his situation so close to his operation, he lacks the proper perspective of results. What seems good to him may seem bad to the visiting engineer who brings a fresh and untrammeled mind to the problems.

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The best insurance to the stockholders, against conditions of this kind, is the technical audit. They can get no such assurance from the balance sheet. They should not allow dividends to lull them into a state of satisfaction with their management, nor should they regard the failure of dividends as proof of its incompetence. A technical audit need not be performed every year, perhaps, but it should be a feature of the annual report every two or three years, at least such portions of it as can be given publicity without the risk of harm to the business.

Naturally, the value of a technical audit depends on the selection of the ablest engineer available. It may be said that such service costs money, as indeed it does, but the cost is trivial compared with the profit to be derived. An engineer for such service must have had the broadest experience in all the branches of the industry involved. He should not be a specialist on some particular section of the operation, as such an one might, by some change, uncoördinated with the whole operation, affect the total result adversely. The examining engineer must view the operation as a whole and see that all departments are coördinated, to the end that improvement in one may appear as an improvement in the total and not be at the expense of efficiency in some other department. Taking up a technical audit in detail, it would consist of:

1. A discussion of the conditions surrounding the enterprise, such as transportation facilities, labor supply, power supply, water supply and other auxiliary external factors;

2. The supply of raw materials, conditions influencing the supply or production, including discussion of methods in use and alternate methods suggested;

3. The plant, its equipment, arrangement, etc., discussion of process, methods of operation and operating results;

4. Costs, involving a discussion of detailed costs and the influence of any suggested improvements;

5. Profits, involving a discussion of future markets, selling methods, etc.;

6. Organization and personnel; being a discussion of the industrial organization and cricitism of employees.

It might seem to the layman that such a report would be denominated a business audit. As a matter of fact, that is what it is, and the man to make it is the engineer, because the engineer is, first and foremost, a business man. Engineering is commercialized science, the application of science for the creation of wealth, and no man who, in applying his knowledge, forgets that such is the object, deserves to be called an engineer.

## A. S. T. M. Methods for Analysis of Lead, Tin, Antimony and Copper Alloys

THE American Engineering Standards Committee has before it, for approval as Tentative American Standard, A. S. T. M. Standard Methods for Chemical Analysis of Lead, Tin, Antimony and Copper (B18–21), submitted in accordance with the special procedure under which important standards in existence prior to 1920 may be approved without going through the regular process followed in new work.

These methods as first recommended to the A. S. T. M. in 1917 were based on methods of analysis in use by manufacturers, analytical chemists and other users of the alloys. In 1920, partial revision was made following suggestions of the U. S. Bureau of Standards, and as a result of coöperative analytical work carried out by members of the committee and other chemists. The methods are in the 1921 volume of the A. S. T. M. Standards. Copies may also be obtained from the American Engineering Standards Committee, 29 West 39th St., New York City. Price 25 cents.

The A. E. S. C. would be glad to learn the extent to which these methods meet the needs of the industry.

## Institute of Economics

THE *New York Times* of April 21 announced the establishment of an Institute of Economics which will undertake to supply to private individuals, business concerns and to Government officials reliable information on all economic questions. To finance the new institution, for which there is said to be no precedent, the Carnegie Corporation of New York has set aside $1,600,000. This is expected to pay the costs of the undertaking for ten years. The home of the institute will be in Washington, D. C.

The institute will maintain a paid staff of expert investigators to gather, collate and distribute, or make available, this information in a manner so scientific that its reliability may be unquestionable. Researches will be conducted into every phase of the economic field, but will be confined to present and past conditions. There will be no attempt to forecast possibilities by any system of indices such as are used by economic publications.

The institute's information will be made available through publications, possibly bulletins and pamphlets, and the work will be developed in coöperation with other economic bodies of recognized standing, and with colleges, universities and other institutions.

The first Board of Trustees includes Dr. Arthur T. Hadley, president emeritus of Yale University; Dr. A. Lawrence Lowell, president of Harvard; Dr. Charles D. Walcott of the Smithsonian Institution; Dr. Edwin A. Alderman, president of the University of Virginia; Dr. David Kinley, president of the University of Illinois; Paul Warburg, former member of the Federal Reserve Board; John Barton Payne, chairman of the Central Committee, American Red Cross; Robert S. Brookings, St. Louis; Charles L. Hutchinson, Chicago; David F. Houston, James J. Storrow, Boston; Bolton Smith, Memphis; Whitefoord R. Cole, Nashville; Samuel Mather, Cleveland, and George Sutherland, Salt Lake City.

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# Revision of the Mining Law*

By W. R. INGALLS

Consulting Engineer, New York City

THE bases of the work by the committee whereof I am chairman were (1) the abolition of extralateral rights and (2) the preservation of the maximum of the existing laws. The matter of extralateral rights had been under prolonged discussion among mining men and up to the time when our committee began its work (in 1917) the expression of opinion in every way whereby it could be made known —and those ways were extensive—was only a little short of being unanimous that extralateral rights ought to be abolished. I have not observed important evidence indicating a change of opinion on the subject since 1917.

### Abolition of Discovery Logical

Now, when it be decided that extralateral rights ought to be abolished, there can not be merely a simple change to that effect, but it is found that consequential changes are necessary all the way through the existing laws. Abolition of extralateral rights implies abolition of discovery as a prerequisite to location, for otherwise there would be no legal means for locating claims on the dip of a vein. Quite apart from this consideration, abolition of discovery as a prerequisite to location is supported by other good reasons. Among these are the occurrence of orebodies with no exposure on the surface and which often are hidden at great depth. A prospector who has reason to suspect the occurrence of such an orebody must have legal means for the location of a claim within which to explore, and obviously he may not be able to make any discovery on the surface sufficient to locate and hold legally such a claim under the terms of the law as it stands at present.

As a matter of fact, discovery as a prerequisite to location was abolished by common consent many years ago, not only for the reasons that I have given hereinbefore but also for others. It is highly desirable to revise the mining law in this respect, so that it will conform to the conditions of practice and not require people to perjure themselves in making locations, even if it be for praiseworthy purposes.

Formal abolition of extralateral rights implies, moreover, that there is no longer any need for discrimination between placer and lode claims. Moreover, it implies that there is no need for tunnel locations. All complexities and perplexities under those heads therefore can be eliminated from the existing laws; and all desirable forms of location can be made by one type of claim, applicable to all forms and kinds of mineral deposits, except those (coal, petroleum, salines, etc.) that have previously been reserved by the leasing acts. This simplification is accomplished by H. R. 7736.

Further links in the chain of reasoning are that abolition of extralateral rights implies square claims (which we have already in our placer claims, and to which our people are consequently accustomed). Furthermore, it follows that while discovery may be abolished as a prerequisite to location, the whole spirit of our customs, practice and thought requires that it be preserved as a condition for patenting. Therefore, there must be some means for the certification of discovery in cases where a person has been permitted to make location without discovery and this is especially necessary when discovery be made by drill holes or in any way that can not be subsequently observed by everybody.

There are other features introduced into the proposed bill that are not consequential upon abolition of extralateral rights but which reflect the desire to correct admitted evils. In the first place, the existing laws are scattered through the statutes. Collection of them in one place and codification are desirable. This is going to be done anyway, and it is more to the interest of the mining industry to have it done now by mining men than to have it done later by persons who are not so experienced in the industry, and who may not be so much in sympathy with it. As to details, there is a general feeling that the methods of marking claims should be improved, that the system of recording should be improved, etc.

### New Conditions Requiring New Laws

Finally, there are new conditions that have arisen in the prosecution of the mining industry which the present laws do not fit at all, and as to which difficulties are likely to be intensified in the future. Among these are the need of mining companies operating on a large scale to obtain large areas of ground for works,

* The Committee on Mines and Mining of the House of Representatives held its first hearing on H. R. 7736 in Washington on April 27, 1922, and by invitation W. R. Ingalls, chairman of the committee of consulting engineers of the U. S. Bureau of Mines which drafted the bill, appeared before the congressional committee in order to explain it. Dr. H. Foster Bain, director of the Bureau of Mines, was the first witness. He described the steps that led to the appointment of the committee in the U. S. Bureau of Mines. Mr. Ingalls followed. This is the concluding part of his statement.

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storage of strippings, tailings, etc.; and legal authority for the holding of ground while prospecting for covered ore deposits, perhaps at great depths. Our existing laws do not contemplate such conditions and make no provisions for them.

Our committee may not have formulated the best ways of meeting all of these contingencies, but its general recommendations ought not to be carelessly dismissed, or be condemned offhand. There are some details in the committee's draft that have excited opposition, as to which the committee itself would say that they are unimportant. There are other stipulations as to times, dimensions, etc., for which the committee would cheerfully accept substitutes, if it were convinced that something better were offered. However, it should be borne in mind that such features were generally the result of compromises among the committee, reflecting differences of opinion in the mining industry.

Sometimes these compromises were important, and at other times unimportant. Among the more important were the size of claims, the areas that might be held by a single locator, the matter of annual assessment work, etc.

### Assessment Work and Size of Claims

As to size of claims, there were two radically different views, reflecting differences of opinion in the preliminary discussion among the mining societies and industrial organizations, which came right up into the committee. The mining men of the Northwest generally wanted a square claim of large area. They were acquainted with the large claims of British Columbia. On the other hand, the mining men of the Southwest wanted square claims of small area. They were acquainted with the *pertinencias* of Mexico. The question crystallized between a 40-acre unit and a 10-acre unit. In this particular case, the committee hit upon a compromise that was rather ingenious, I think, in that it provided for alternative units, either of which may be used by the locator as best meets his needs.

With respect to the question of annual assessment work, a good many mining engineers, expressing their opinion without any considerations of psychology and the customs of the "old prospector," were in favor of the abolition of this feature of the existing laws and the substitution of a cash payment to the Government. Our committee recognized the merit of such a recommendation, but it appreciated also that there would be popular dislike for such a provision. We sought to make a compromise between these two views by providing for the continuance of the annual assessment-work idea just as it has been in the past but providing the alternative that persons desiring to pay cash in lieu of assessment work might do so. This is to give people the means for avoiding the performance of utterly useless work, which is simply an economic waste. Even so, our committee contemplated keeping the equivalent within the mining district to which it was due, arranging only that it should serve a useful purpose, such as road building. The protests that have arisen against these considerate and rational provisions are incomprehensible to me.

Another detail in H. R. 7736, as to which opposition has been expressed, and in this case I think it is rather widespread, is that which prescribes for the location of claims in conformity with the lines of the public-land survey. Our committee started with a disagreement as to this, but in the end was unanimous in favor thereof. This was one of the questions as to which there was yielding in order to arrive at an agreement. In the end our committee considered this to be a desirable improvement in our mining laws, but I am sure that the committee would be very far from considering this provision to be an essential. A modification of this to the effect that anyone might locate a claim without regard to the public-land survey, with the proviso that if he did make a location in conformity therewith he would be relieved from the obligation of making a survey for patenting, would meet with the assent of our committee; or, for that matter, so would the omission of any provision with reference to the public-land surveys. The question is one of relatively minor importance in a broad consideration of the revision of the mining laws.

The report of our committee was made to the director of the Bureau of Mines nearly a year ago. The draft for a bill which accompanied it was introduced as H. R. 7736, under date of July 12, 1921, for the purpose of giving it wide publicity and invoking criticism and suggestion. A considerable number of communications regarding it have been received by Mr. Arentz, by the Bureau of Mines and in other quarters, and in a general way I am familiar with them. A good many of these criticisms have reflected mere misunderstanding of the provisions of the proposed bill. A good many of them have been directed against articles which are provisions, word for word, in the existing laws, which our committee did not see fit to alter, acting in this respect upon one of its fundamental principles, *viz.*, to make the minimum of changes from the existing laws.

### Objections Summarized

Mr. Arentz has summarized the objections coming to his attention under five heads: (1) The abolition of extralateral rights; (2) the abolition of discovery as a prerequisite to location; (3) the alternative of a cash payment in lieu of annual assessment work; (4) the requirement for locations to be in conformity with the public-land survey; and (5) the mill-site (or dump) provision. I have already dwelt upon each of these topics in this memorandum. Questions 1 and 2 are fundamental. Questions 3 and 4 refer to details which are in no wise essential in a revision of the mining laws. Question 5 relates to a subject that is of great

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importance. This pertains not merely to a change in the existing laws, but is an introduction of new matter. The conditions of mining as they are to be foreseen in the future demand something of this nature. Our committee gave the best prescription that it knew how to do, but will welcome any suggestion for improvement. The theory of the formulation that we made is to facilitate large-scale mining operations and at the same time guard public interests. The terms for the acquisition of large areas of ground that we have provided are so onerous that no one will seek to take advantage of them except for legitimate purposes. It is to be noted, moreover, that they confer nothing but surface rights, the mineral rights in such areas being reserved to the Government.

The only thought of our committee throughout its deliberations, which lasted for nearly four years, was of the general public welfare. There were, indeed, introduced provisions looking forward to large-scale mining, naturally for the reason that mining of the future is likely to be so to an increasing degree and there should be good legal means to provide what is necessary. The "old prospector" is left about where he was. If anything, conditions are made easier for him. He can legally take up ground without having to make a discovery or to perjure himself. He is allowed to go upon land that is classified as "non-mineral land." He has only to be a little more orderly in the matter of monumenting and recording and that is to his own interest, the increased protection that is thus afforded to him being well worth his while. If he makes a location without discovery, and subsequently makes discovery, only then does he have to have it certified. Really this does not concern the "old prospector," who goes out and finds a mineral deposit and locates a claim upon it. If he does that his subsequent procedure is substantially the same as heretofore, and he may continue to hold his claim by doing his annual assessment work just as now.

The position of existing claim holders is in no way altered except in their favor. That is to say, they have all the rights and titles that they now possess, extralateral and otherwise, but in addition thereto the present owner of a claim is given everything comprised within his vertical planes that does not belong to anybody else. In other words, an existing claimholder with a location on the apex of a vein retains the right to follow the extension of the vein beyond his side lines, but if there be found within his vertical planes any other orebody, that also is given to him providing no other person has a legal claim upon it.

The committee owed responsibility to nobody but the Federal Government. It was not bound by any expressions of opinion that had been made, or resolutions that had been passed previously by societies. Its sole duty was to draft a bill providing for a revision of the mining laws that would in its judgment serve best for the mining industry and the national welfare.

## Division of War Minerals Supply

THE U. S. Bureau of Mines has established a Division of War Minerals Supply, to be responsible for matters relating to the supply of strategic minerals involved in war plans of the Government, the maintenance of a proper balance of trade among the mineral industries of the nation, and such related duties as may from time to time be assigned to it. H. S. Mulliken, who has for some time acted as special assistant to the director of the Bureau, has been given charge of the work of this division.

The division will coöperate with the General Staff of the War Department, the United States Geological Survey, and a special committee of the American Institute of Mining and Metallurgical Engineers (Arthur S. Dwight, George Otis Smith, H. Foster Bain, J. Edward Spurr, Pope Yeatman, C. K. Leith) in the proposed study of sources of supply and potential production of certain especially selected war minerals.

The head of the division will serve as chairman of the Committee on Strategic Minerals of the Economic Liaison Committee. He has also been placed in administrative charge of all activities in the production of helium that may devolve on the Bureau of Mines, and will serve as one of the Bureau's representatives on the Army and Navy Helium Board.

## Investigation in Wisconsin Zinc District

SINCE the beginning of the milling to recover zinc, the Wisconsin field has borne an undesirable reputation on account of the marcasite which is associated with the sphalerite. The separation has been difficult. A fairly satisfactory process of magnetic separation for grading up jig concentrates which are contaminated with marcasite has been in operation for some time, but the fines are not amenable to this process and have been wasted.

Laboratory tests made by the Bureau of Mines at the Wisconsin State Mining School, Platteville, Wis. indicate that concentrating tables will recover 90 per cent. of the zinc content in a low-grade concentrate assaying about 20 per cent. zinc, and that this concentrate can be graded up to 62 per cent. in central plants where flotation and gravity concentration are combined. An estimate has been made that this practice would have added about one million dollars annually to the revenue for zinc. In some instances the lead recovered would have been appreciable. Two by-products, marcasite and ground limestone would have been available for sulfuric acid and agricultural purposes, respectively.

**A Bibliography** of literature on sampling, compiled by W. J. Sharwood and M. W. Von Bernewitz, has been issued by the U. S. Bureau of Mines. A copy may be obtained from the Director of the Bureau of Mines, Washington, D. C. Ask for Serial No. 2336.

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# Government Action of Interest to Engineers

## Extract from Weekly Bulletin Issued by American Engineering Council

MAY 19, 1922

**Coal Conference.**—On May 18, the Secretary of Commerce presided at a meeting of representatives of the coal operators now producing coal, at which a committee was appointed to carry into effect the following proposals: The establishment of district committees to coördinate distribution; the setting up in Washington of a committee to act as a clearing house for the regional committees; Garfield prices put into effect late in 1917 to be the basis for computing fair prices at the mine. In addition, it is planned to conduct the buying for railroads, public utilities and metallurgical plants through centralized committees. Measures also are to be taken to insure the direct progress of coal between producers and consumers. It is hoped to prevent speculation and the pyramiding of prices.

**Muscle Shoals.**—Before the Senate Agricultural Committee, O. C. Merrill, executive secretary of the Federal Power Commission, gave but scant support to proposals by private interests. The House Military Affairs Committee has asked the Attorney General to pass on the validity of contracts executed by the War Department to the Alabama Power Co. in connection with the dam at Muscle Shoals.

**Tariff.**—Leaders will not estimate when this bill may be expected to become law.

**Commodity Divisions to Expand.**—The success which has attended the operation of the commodity divisions in the Department of Commerce has led Congress to appropriate the money for an expanded program in that work. More money will be available for the more important of the existing divisions and new divisions will be set up after July 1, which include separate units to be devoted to export trade in chemicals. The fuel division will be divided and separate units made of coal and petroleum.

MAY 12, 1922

**Muscle Shoals.**—Senator Norris, chairman of the Senate Committee on Agriculture, which is investigating the offers made for the Government properties at Muscle Shoals, has expressed the positive opinion that no one of the offers should be accepted, but that the Government should handle the project itself. Dr. William McClellan, president of the American Institute of Electrical Engineers, and a member of the Executive Board of the Federated American Engineering Societies, appeared before the Senate Committee and urged that Congress take no action until the whole proposal had been submitted to an engineering board of review. He promised to arrange for the services of a committee, to consist of not less than five engineers having long experience with large projects, to make a report to Congress for the handling of the property along business lines.

**Patent Convention.**—The Patent Convention with Germany was revived when formal notice was given Germany, on May 8, that it is the desire of the United States to continue that agreement. The War Department and the manufacturing chemists oppose the revival of the Treaty, but the evidence presented showed clearly that while there would be certain advantages in allowing the convention to elapse, they would be outweighed greatly by the disadvantages. Chemical interests have proposed a compromise to the Senate Patents Committee.

**Tariff.**—After 20 days of discussion, the Senate adopted the Finance Committee's amendments applying to the first paragraph of the tariff bill which prescribes rates for certain acids and anhydrides. It was pointed out that Germany is receiving more chemicals from the United States than she is exporting and in reply it was said that this condition is temporary and that an exact balance in trade between any two nations is not necessary. In an effort to expedite the passage of this bill, the Senate is being convened an hour earlier in the morning and is holding night sessions.

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## Froth Flotation of Coal

INVESTIGATIONS conducted by the U. S. Bureau of Mines at the University of Washington, show that there is no reason, technically, why many American coals cannot be successfully cleaned of part of their ash and refuse by froth flotation. The process has already been put into successful commercial practice in England and in other foreign coal fields. Its commercial success in this country must, of course, depend on its cost as compared with the present cost of putting clean coal on the market.

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# Outlines of the Mining Industry in the Russian Far East*

By P. P. GOUDKOFF

Professor of Economic Geology, Vladivostok Polytechnic Institute

UNDER the name of the Russian Far East we understand the territory occupied by the Amur, Maritime, Sakhalin and Kamchatka Provinces, the total area of which is about 918,000 square miles. The mining industry took its first step in the Russian Far East in the second half of the 19th century, and until the end of this century was restricted to gold placer mining. In the last years of the 19th century, the extraction of coal and lignite was begun, and in 1910–11 the exploitation of silver-lead-zinc mines.

The conditions of the Far Eastern mining industry during the last few years may be outlined by the following figures:

Annual production of gold mines was about 54,000 lb., valued at $13,000,000. During the period of 1910–15 a considerable increase of placer-gold mining by mechanical processes took place; in 1910, by means of dredging and excavators, 500 lb. of gold were obtained; in 1914, 2740 pounds.

Annual output of coal, lignite and silver-lead-zinc ores was:

| | 1911 | 1920 |
|---|---|---|
| Bituminous and semi-anthracite coal, long tons | 270,000 | 316,000 |
| Lignite, long tons | 66,000 | 205,000 |
| Silver-lead-zinc ores, long tons | 28,400 | 94,500 |

In other branches of mining in the Far East, only the quarrying of building stone and clay may be mentioned, the total yearly output amounting to about $500,000 in value.

The principal gold mines are in the Amur Province, in the systems of the Zeia and Bureia rivers, and in Kamchatka Province, near the town of Okhotsk. The above-mentioned tonnage of coal and lignite was extracted from the mines in the Maritime Province, near Vladivostok. The only silver-lead-zinc mine worked was that of Tetiukhe, near the Tetiukhe Bay, 240 miles northeast of Vladivostok. The ores of this mine were exported to Germany, Belgium, and Japan, partly raw, partly calcined.

The slow development of the mining industry in the Far East has been due mainly to the following causes: entire lack of capital; failure to explore the territory; restraints upon initiative due to the closing of certain regions to private mining enterprises, and to the vacillating policy in regard to the employment of yellow labor, such employment having been at one time allowed, at another prohibited.

On the other hand, easy accessibility to the sea, a well developed system of navigable rivers, abundant and widely distributed forest tracts, and a plentiful supply of cheap labor make possible the exceptionally favorable development of the mining industry in the Far East.

## Possibilities of Various Fields

Although more than 83 per cent. of the territory of the Russian Far East still remains unexplored, there have been recorded within its boundaries 713 deposits of 27 different useful minerals, not counting placer gold. Prospects in the different fields may be summarized as follows:

*Gold Mining.*—The opening of new gold-bearing regions; the improvement of placer mining by the introduction of mechanical devices; the development of quartz mines. The gold placers in the Far East are estimated to contain about 13,320,000 lb., worth $3,700,000,000, and it may be said that of all the countries bordering on the Pacific Ocean, the Russian Far East offers the greatest possibilities for the development of gold mining.

*Coal Mining.*—The coal and lignite resources in the known fields are estimated, in millions of long tons, at

| | Coal | Lignite |
|---|---|---|
| Amur Province | 5 | 400 |
| Maritime Province | 70 | 200 |
| Sakhalin Province | 2000 | 2 |
| Kamchatka Province | Very considerable | Considerable |

Among the known coal fields, those in Sakhalin contain high-grade low-ash long-flame and coking coal. The importance of the great resources already located gives us the right to expect their development hand in hand with an increase of the merchant marine, the inevitable change of the river shipping from wood to mineral fuel, the probable development of the metallurgical industry, and the increasing demand for coal and coke in neighboring countries.

* Presented at the Directors' dinner, A. I. M. E., Engineers' Club, March 24, 1922.

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*Silver-lead-zinc Mining.*—Broad prospects are opened up in connection with the probable discovery of additional valuable deposits in the region of the Tetiukhe mines, the advantageous geographical location of this region, and the favorable market conditions for these metals; in particular, with the noteworthy demand for silver, lead, and zinc in Russia, and for silver in China.

*Oil.*—Oil seepages are known on the eastern coast of Sakhalin, where a strip of seepages is found to extend 231 miles. The oil-bearing horizons are evidently related to the Upper Tertiary. The quality of the oil is not yet determined, but it is clear that with depth the amount of kerosene fractions increases, reaching as high as 44 per cent. It is very probable that in Sakhalin different kinds of oil will be found, as in Japan. There are also unverified data on the seepages of oil on the western coast of Sakhalin and in the Kamchatka Province.

The development of the mining industry of the Russian Far East is of great importance to the general economic situation in the Pacific. On the one hand, it will make the Far East a large market for foreign machinery, and for various materials necessary for the equipment and supply of mining enterprises; on the other hand, it will permit the Russian Far East to contribute its share to the general prosperity of the Pacific through its exports of lead, zinc, silver, rare metals, Sakhalin coal and oil.

## Broken Backs not Fatal

IN RECENT years, according to a statement by Dr. John M. Griffin, superintendent of the Miners' Hospital at Albia, Iowa, out of 44 cases of broken back among coal miners operated on at the Miners' Hospital, 19 have been enabled to return to productive labor in the mines, due to the proper handling of the cases at the time of injury, by the miners skilled in first-aid methods.

A wonderful improvement in the condition of injured miners brought to the hospital for treatment has been noticeable in recent years, says Doctor Griffin's report. Before first aid was instituted among the miners by the U. S. Bureau of Mines, it was not uncommon to have tetanus follow slight injuries. The men now realize the importance of antisepsis and asepsis and have minimized the cases of infection of all kinds by their first-aid dressing. First aid has also taught the men the importance of immediate care of all eye injuries, which means the saving of many eyes in the course of a year.

In fractures and dislocations, first aid has prevented the further injuring of an already injured man, and has made it possible to save many men who otherwise would have been permanently disabled or would have died.

## Authority on Mineral Wealth of Siberia

PROFESSOR P. P. Goudkoff, author of the article that begins on the preceding page, has made extensive investigations of Siberian mining fields. He is in the United States, working on the problem of the restoration of the mining industry of Siberia and the rational future exploitation of its seemingly inexhaustible mineral wealth.

Professor Goudkoff has made geological investigation of more than 300 copper beds in Akmolinsk Province (Kirghiz Steppes); has participated in the work of investigating the Poklevsky-Kezel gold mines in the Urals; has made geological investigation of the gold mine "God's Gift" in Eniseisk Province and the "6th Berikoulsky Plateau" mine in Tomsk Province. He surveyed the Mariinsky and Berikoulsky gold mines in Tomsk Province, as well as several other large mines and mining districts.

P. P. GOUDKOFF.

By order of the Siberian Government, Professor Goudkoff organized the Siberian Geological Committee and was elected first president of that committee. During the Koltchak Government, he was appointed Minister of Commerce and Industry.

## Briquetting Zinc-bearing Material for Distillation

AS a step in the electrothermic smelting of zinc ores, some large-scale briquetting tests were initiated on roasted ore and on a zinc residue concentrate at the Mississippi Valley Experiment Station of the United States Bureau of Mines. Briquettes made of ore, coke, and pitch were shipped to a smelter at Ft. Smith, Ark., for distillation in a natural-gas fired furnace. Ordinary retort distillation on the residue concentrate (containing 36.0 per cent. Zn., 9.5 per cent. Fe., 21 per cent. Pb, 3.1 per cent. CaO, and 3.2 per cent. S.) results in a low recovery of zinc and rapid destruction of retorts. The distillation of this material in briquette form resulted in 97 per cent. zinc extraction, although only 70 per cent. was recovered on account of cold furnace fronts because of partial firing of the furnace for the experimental work. Retort destruction is practically absent with the briquettes and a larger charge can be handled in retorts when in briquette form.

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# Oil and Gas Education*

By ROSWELL H. JOHNSON

Professor of Oil and Gas Production, University of Pittsburgh

A CANVASS of the various institutions known or suspected to be giving courses dealing with petroleum and gas revealed the courses listed in the accompanying table, which includes a summary of the number of class hours, as a whole, of the courses listed. It will be observed that the situation is gratifying. Courses are presented in different institutions in the main geographic sections of the country, so that students have no difficulty in obtaining education in this field.

The committee believes that the courses that are offered in many institutions are so inadequate in amount as to make it unwise for students who have not had additional work to consider themselves trained in this field. We strongly urge the few schools now presenting the most adequate courses to develop these more fully, bringing their work up at least to 300 hours, and let other schools concentrate their energies in other fields.

## Specialization Suggested

Three schools in Texas give work in this field and it seems to the committee that it would be far better if an amicable arrangement could be reached whereby one of these schools would specialize in mechanical petroleum engineering and another in chemical petroleum engineering. In California, specialization is already in effect, the economic aspects receiving special attention at Leland Stanford University and technology at the University of California. We suggest that this differentiation be continued.

We recommend that national differentiation be recognized and furthered as follows:

Mechanical field in University of California.

Chemical in University of Oklahoma.

Economic at Leland Stanford University and University of Pittsburgh.

Oil shale at Colorado School of Mines.

The geological work should be adequately treated in all the schools giving petroleum engineering of any type.

The Mid-Continent Oil & Gas Assn., in order to assist students in the various institutions of Texas who intend to enter the oil business, has instituted a series of lectures by practical oil men at the Agricultural and Mechanical College of Texas and the University of Texas. The Association sends to the College once a month a specialist on a particular line of the oil business, such as the geology of oils, production, pumping, refining, preparation of lubricating oils, etc. The Association also plans to provide employment in the oil fields for students from these institutions, so that they may have a practical insight into the business.

The Committee on Education approves this arrangement and hopes that its benefits may become national by similar undertakings in other fields.

*Report of the Committee on Education, Oil and Gas Section of the American Institute of Mining and Metallurgical Engineers.

*Courses on Oil and Gas at Different Institutions*

| Institution | Courses | Hours per Week | Number of Weeks | Total Class Hours | Number of Students |
|---|---|---|---|---|---|
| University of Pittsburgh. | Geology of oil and gas. | 4 lec. 3 lab. | 18 | 468 | 34 |
| | Comparative oil fields. | 4 lec. 6 lab. | 18 | | 33 |
| | Business of oil and gas production | 2 | 18 | | 17 |
| | Technology of oil and gas production | 2 | 18 | | 15 |
| | Appraisal | 2 | | | 18 |
| | Examination and reports | 6 | 18 | | 12 |
| | Oil and gas laboratory. | 12 | 18 | | 16 |
| | Advanced oil and gas laboratory | 9 | 18 | | 15 |
| | Seminar in oil and gas. | 3 | 36 | | 39 |
| | Chemistry and refining of petroleum | 2 lec. 6 lab. | 18 | | |
| | Physical and chemical testing of natural gas and petroleum products | 1 lec. 6 lab. | 18 | | |
| | Geological methods | 1 lec. 3 lab. | 18 | | 31 |
| | Applied scientific method | 2 lec. 3 lab. | 18 | | 34 |
| University of California. | Oil-field development. | 2 | 16 | 352 | 54 |
| | Petroleum production methods | 2 | 16 | | 30 |
| | Petroleum engineering laboratory | 6 | 16 | | 20 |
| | Petroleum cost accounting | 1 | 16 | | 17 |
| | Petroleum utilization. | 1 | 16 | | 46 |
| | Production and utilization of natural gas | 1 | 16 | | 26 |
| | Undergraduate thesis. | 6 | 16 | | 4 |
| | Research and seminar in petroleum technology | 6 or 2 | 16 | | 19 |
| | Oil-field mapping practice | 3 | 16 | | 28 |
| University of Oklahoma. | Petroleum and gas | 5 | 36 | 342 | |
| | Bitumenology | 3 | 26 | | |
| | Petroleum technology. | 3 | 18 | | |
| | Advanced petroleum technology | 3 | 18 | | |
| | Analysis of petroleum, petroleum products and oil shale (lab.) | 9 | 18 | | |
| | Gas and coal analysis (lab.) | 9 | 18 | | |
| | Petroleum technology (lab.) | 9 | 18 | | |
| | Field work in petroleum technology (lab.) | 6 | 18 | | |
| | Petroleum research | varies | varies | | |
| University of Missouri. | Field geology | 6 | 16 | 288 | 11 |
| | Oil and gas lectures† | 3 | 16 | | 16 |
| | Oil and gas lectures | 3 | 16 | | 15 |
| | Oil-production methods | 3 | 16 | | 14 |
| | Oil-mapping and graphic charts | 3 | 16 | | 4 |
| | Oil engineering drafting | 12 | 6 | | |

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| Institution | Courses | Hours per Week | Number of Weeks | Total Class Hours | Number of Students |
|---|---|---|---|---|---|
| | Graphical presentation of oil statistics | 6 | 16 | | |
| | Valuation of oil properties | 6 | 16 | | |
| Leland Stanford University. | Principles of petroleum mining | 3 | 10 | 200 | 60 |
| | Petroleum geology | 3 | 10 | | 20 |
| | Oil-land valuation | 1 | 10 | | 20 |
| | Oil-field development | 2 | 10 | | 20 |
| | Production of oil | 2 | 10 | | 20 |
| | Storage and transportation of petroleum | 2 | 10 | | 20 |
| | Petroleum refining and utilization | 3 | 10 | | 20 |
| | Advanced work in petroleum engineering | 1–5 | 10 | | 15 |
| | Petroleum research and thesis | 1–5 | 10 | | 10 |
| | Seminar in origin and accumulation | 4 | 10 | | 20 |
| Yale University. | Petroleum geology | 2 lec. 1 lab. | 38 | 228 | |
| | Advanced petroleum geology | 4 lec. 8 lab. | 38 | | |
| Agricultural and Mechanical College of Texas. | Petroleum geology | 3 lec. 3 lab. | 36 | 224 | |
| | Industrial chemistry (may specialize in petroleum). | 3 lec. 3 lab. | 36 | | 40 seniors |
| | Lectureship instituted by Mid-Continent Oil and Gas Assn. | Evening | Once a month | | |
| University of Texas. | Geology of petroleum | 5 | 36 | 180 | 6 |
| New Mexico State School of Mines. | Oil and gas geology | 2 | 18 | 162 | |
| | Oil analysis (special) | | | | |
| | General petroleum geology | 3 | 18 | | |
| | Structural and field geology applied to oil. | 2 lec. 8 lab. | 18 | | |
| University of Nebraska. | Structural geology, related to oil and gas | 2 | 18 | 144 | |
| | Oil and gas geology | 4 lab. | 36 | | |
| | Topographic and surface geologic mapping | 2 | 18 | | |
| | Oil and gas chemistry | 4 | 18 | | |
| Mississippi Agricultural and Mechanical College. | Oil geology | 6 | 18 | 108 | |
| Colorado School of Mines. | Petroleum and shale-oil analysis | 1 lec. 3 lab. | 18 | 90 | Pet. Eng. 27 Chem. Eng. 12 Min. Geol. 115 |
| | Petroleum and shale-oil technology | 1 | 18 | | |
| | Geology of oil and gas | 2 | 18 | | |
| | Oil-field development | 1 | 18 | | |
| University of Kansas. | Petroleum resources | 5 | 18 | 90 | 6 |
| University of West Virginia. | Oil and gas geology | 2–3 | 18 | 90 | 5 |
| | Oil and gas production (lec.) | 2 | 18 | | 8 |
| | (lab.) (chemistry) | 2 | 18 | | 2 |
| Massachusetts Institute of Technology. | Geology of coal and oil (3 terms) | 3 | 10 | 80 | |
| | | 2 | 10 | | |
| | | 3 | 10 | | |
| University of Arizona | Petroleum geology | 2 | 36 | 72 | |
| University of Wisconsin. | Oil geology (alternate years) | 2 | 18 | 72 | 21 |
| | Industrial organic chemistry, emphasis on petroleum refining. | 2 | 18 | | |
| University of Chicago. | Petroleum geology | 4–5 | 12 | 60 | |
| University of North Carolina. | Oil geology | 5–6 | 12 | 60 | |
| University of Utah. | Petroleum geology | 5 | 12 | 60 | 15 |
| Southern Methodist University. | Economic geology—A study of fuels—oil geology | 3 | 18 | 54 | 12–20 |
| Oklahoma Agricultural and Mechanical College. | Petroleum technology | 3 lec. 6 lab. | 18 | 54 | |
| Ohio Wesleyan. | Geology, coal, oil, gas | 3 | 18 | 54 | |
| Dennison University. | Petroleum geology | 3 | 18 | 54 | 15 |
| Harvard University. | Geology, dealing with oil and gas. Given in coöperation with M. I. T. Lectures by well-known men | 3 | 16 | 48 | 25–40 |
| University of Idaho. | Petroleum geology | 2 | 18 | 36 | |
| University of Kentucky. | Oil geology | 2 | 18 | 36 | 12 |
| University of Minnesota. | Geology of petroleum | 3 | 12 | 36 | |
| University of Nevada. | Petroleum industry (graduate course) | 2 | 18 | 36 | |
| Pennsylvania State College | Geology of coal, oil and gas | 2 lec. 3 lab. | 18 | 36 | |
| State College of Washington. | Petroleum geology | 2 | 18 | 36 | |
| Oregon Agricultural College. | Oil geology | 1 lec. 2 lab. | 18 | 18 | |
| Cornell University. | Oil geology | | | | |
| Columbia University. | | | | | |

## Liquid-oxygen Explosives

EFFORTS have been made by George S. Rice, chief mining engineer of the Bureau of Mines, to have liquid-oxygen explosives tried out practically in this country, but oxygen-liquefying plants are not made in the United States, which limits the use of these explosives in America. In Germany oxygen-liquefying plants are manufactured in various sizes in complete units of apparatus and containers.

Since the war the only extensive development outside of Germany has been in the Lorraine iron mines, where the Germans installed apparatus, and additional apparatus has been put in by the French. One company in Lorraine is mining its entire annual output of 1,500,000 tons of iron ore by the use of these explosives. This company has developed a cartridge of its own on which it has received patents, and has applied for others. It is claimed that the cartridge is an improvement on the German cartridge. The Germans use, for brisant effects, soot; and for slow heaving effects, wood pulp. Either fuse or electric detonators can be used for igniting the charge. The Germans have now developed a method of placing the electric detonator in the bottom of the hole in a special container and have been able to fire large rounds, it is claimed as high as 28 shots at a time.

## Mexican Chamber of Commerce

THE Mexican Chamber of Commerce of the United States, Inc., has been organized to promote business and economic relations between Mexico and the United States, to spread general information of reciprocal interest, and to foster friendly relations. The Board of Directors has 16 members, citizens either of the United States or of Mexico, among them being Elbert H. Gary; the officers are: Sealtiel L. Alatriste, president; James W. Gerard, vice-president; Jerome S. Hess, vice-president; Russell R. Whitmann, vice-president; J. M. Bejarano, treasurer; Jose Romero, secretary.

The offices are in the Woolworth Building, New York City, and at 45 Bolivar St., Mexico City.

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# Technical Committee Reports

THE Institute Committee on Industrial Relations, of which Robert Linton is chairman, held a meeting on Feb. 21, listed as one of the technical sessions of the annual meeting, at which reports of the sub-committees were presented. Following are abstracts of these reports. The Institute can furnish mimeographed copies of the complete reports on Safety, Employment, Illness, Mental Factors, and Cripples in Industry. The supply of the other reports has been exhausted.

A paper by George F. Kunz, which was presented at the same meeting, is printed here in full.

## Education

By Charles R. Hook, Chairman of Sub-committee

FOR years there has been no problem of personnel in the industrial world which has had more attention than foremanship.

In any plant, if production is flowing steadily, with a minimum of friction between the departments, if working conditions are good and the men are contented on their jobs, the chances are that that plant has a well organized and intelligent group of foremen. On the other hand, if there is continuous congestion in the flow of work, friction between departments or men, if the men are discontented with their work, their hours or their pay, the chances are that the trouble can be found in the foremen's group. However, the foremen in any plant are largely just what the management encourages, or permits them to be.

The Sub-Committee on Education therefore urges the members of the Institute to undertake to sell the idea of Better Foremanship to industrial managers by showing that a large part of industrial inefficiency is due to the fact that: Foremen as a rule have not been taught leadership; foremen have not been taught how to teach; management has not made a sufficient effort to inform foremen on the problems of management, nor to make "assistant managers" of foremen. In other words, management has belittled the foreman's job.

What is a foreman? Is he a high-class workman, as in some establishments, or is he a low-grade or an assistant manager as in others? He should not be wholly in either of these classes, but rather, a man with knowledge and grasp of the duties and thoughts of the workmen, able to coördinate and direct their effort, and to hold to the point of view of the management. The poorest foremen are those "who use the monkey wrench too much themselves."

Analysis of leadership shows that it is made up of a large number of characteristics; some inborn, and some acquired. The successful foreman must be selected with a view to his natural qualities of leadership, and with a view to his ability to acquire those other abilities which must be acquired by every successful foreman.

A foreman is generally a man who has come up from the ranks of the worker. He usually understands the point of view of those below him and rarely understands the point of view of those above him. The use and results of his particular efforts in a particular part of a plant and their relation to the whole is perhaps blank in his mind. He should be given this point of view through frequent conferences or get-together meetings of the foremen held under the leadership of the management and not through assisting the manager in his duties. The latter plan, often followed in small plants, inclines the foreman too much toward the upper point of view and away from his own function of directing the men and understanding their point of view.

Few foremen will admit upon first thought that teaching is one of their chief duties, yet one of the essential elements of leadership is the ability to transmit one's ideas to others.

Management, too, has given this matter quite inadequate consideration, and foremen can hardly be expected to have a broader view of their duties than management in this matter. Management must take the lead and make adequate provision whereby foremen may be led and helped to give proper consideration to the teaching phase of their jobs.

Perhaps the one factor in industry today which has most to do with low production, low quality and high turnover is mutual distrust. Full and complete information about what management is, its responsibilities, its problems, and its difficulties, works wonders in removing distrust and suspicion from the working force. The foreman is the intermediary for transmitting this information and the interpretation thereof from the management to the men down the line. Management must first form a vital contact with the foreman to post him, to train him on these facts, and further, management must see that the foreman actually does pass this information down to his men. The problem of industrial unrest and distrust will not be solved generally until the foreman is made conscious that he is a party to the facts of management and responsible for the interpretation of these facts to his men.

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# Safety

By H. F. Lunt, Chairman of Sub-committee

IT APPEARED to the sub-committee that it could function most usefully by coöperating with the Mining Section of the National Safety Council, the U. S. Bureau of Mines, and other organizations whose purpose is the promotion of safety in mining and metallurgical industries, and by collecting information regarding safety work, rather than by attempting any special work of its own. The information obtained is summarized below.

## Activities of Organizations Devoted Primarily to Promotion of Industrial Safety

The National Safety Council is an association of employers and others which is organizing and leading the movement for universal safety in this country. It was started in 1913 with 40 members and now has nearly 4000. It publishes a monthly magazine, *National Safety News;* illustrated posters for bulletin boards, "Safe Practices" pamphlets containing engineering studies of various industrial hazards; and maintains, at its headquarters in Chicago, an information bureau and library for answering inquiries regarding all phases of safety work, industrial hygiene and other branches of industrial relations. Local councils are active in various parts of the country. General meetings are held annually in different cities.

The American Society of Safety Engineers was formed in 1915 as a reorganization of the United Association of Casualty Inspectors, originally formed in 1911 by a number of employees of various insurance companies in New York City. This society is a national professional organization of safety engineers, primarily devoted to the development and application of engineering ways and means of accident prevention. Its activities are entirely distinct from the movement to popularize safety.

The Safety Institute of America, which maintains the American Museum of Safety in New York, has been without a permanent director during the greater part of 1921 and has not done as much work as in former years, or as it hopes to do in the future. It has conducted, in conjunction with the Metropolitan Safety Council, courses of lectures for foremen and safety supervisors; maintained a library service; loaned lantern slides and furnished speakers for safety rallies; the publication of its monthly bulletin, *Safety*, has been suspended, but short bulletins have been issued.

## The Bureau of Mines

The U. S. Bureau of Mines has for one of its chief objects the promotion of safety in mining. Following are some of its activities during the past year:

1. Sponsored a successful international mine-rescue and first-aid meet in St. Louis. During this meet an international conference on the standardization of the use of mine-rescue apparatus was held.

2. Studies on dust and ventilation in metal mines were continued and a number of reports on the subject published.

3. At the Pittsburgh Experiment Station an extended study was made of the effect of various percentages of carbon monoxide in atmospheres and the most efficient methods of treating carbon monoxide poisoning.

4. At the experimental mine, near Pittsburgh, some extended experimental work was done in connection with air conditions in tunnels with particular regard to the vehicular tunnel to be constructed under the Hudson River.

5. Experimental work in connection with the coal-dust hazard in coal-pulverizing plants was carried on and some publications on the subject issued.

6. Publications were issued concerning certain hazards connected with the use of chemical fire extinguishers underground.

7. In connection with the U. S. Public Health Service, experimental work on the effect of high temperatures and humidities in mines was carried on and reports were published.

8. A mining engineer was detailed from the Bureau for work in conjunction with the National Safety Council to keep in touch with the mining industry and with progress in safety and to promote interchange of ideas and data between the Bureau and the Council.

## Miscellaneous Safety Activities

A study was made in the mines of South Africa by Orenstein and Ireland of the influence of mine atmospheric conditions on fatigue. An interesting publication was issued as a result of this study.

Explosive companies have continued research work to perfect explosives for underground use from which there would be practically no noxious fumes.

A gas mask, of a type similar to that used during the war, with an absorbent capable of eliminating practically all deleterious gases likely to be found in working atmospheres, was perfected. These masks do not provide oxygen. In nearly all cases where mine atmospheres cannot be breathed safely they are deficient in oxygen and therefore, as they cannot be used in place of oxygen breathing apparatus, these masks should not be used underground. They will, however, doubtless prove useful in smelters and chemical works.

The J. A. Holmes Safety Association presented a number of medals to both coal and metal miners who had performed heroic services in connection with saving life underground.

Dr. A. J. Lanza, formerly connected with the U. S. Bureau of Mines and the U. S. Public Health Service, has been commissioned by the Australian Government to organize a Department of Industrial Hygiene for the Commonwealth of Australia and has taken up this work.

A number of the larger mining and smelting companies have devoted considerable time and effort to the study of accidents in their mines and plants with a view to their prevention. This work is being carried on actively and is showing excellent results in reducing the severity and number of accidents.

Doubtless much other safety work is being carried on which has not come to the notice of this sub-committee. The sub-committee is of the opinion that the greatest progress in safety in mining and allied indus-

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tries can be made by hearty coöperation with the U. S. Bureau of Mines and the National Safety Council. It recommends that the American Institute of Mining and Metallurgical Engineers do everything possible to further such coöperation.

## Employment

By Sidney Rolle, Chairman of Sub-committee

IN THE field of employment many striking yet natural events took place in the year 1921. Despite the fact that nearly all concerns were forced drastically to curtail expenditures of every kind, employment work was generally continued where previously started and in many industries in which such work had been given but little recognition, employment and industrial relations departments were installed. No statistics are available on the stand which the mining and metallurgical industries have taken in regard to this matter. These industries suffered very severely in the last year and it is not at all improbable that some of the good work started of necessity had to be curtailed.

The outstanding feature of 1921, of course, was not employment but, unfortunately, unemployment, and while it is not the function of this committee to go into the problem which has been so ably covered by the President's Conference on Unemployment, of which our own Herbert Hoover was chairman, we wish to call especial attention to the general recommendations of the conference for the emergency program, particularly Item 12, in which recommendations are made to manufacturers (and presumably all industries) for relieving the situation. These recommendations are worthy of careful study, especially to the employment department which can help in carrying them out. Furthermore, it is the opinion of our committee that the calling of this conference, the successful handling thereof, its successful consummation and the recommendations made constitute a splendid achievement which only needs coöperation on the part of all employers and employees to bring far-reaching results.

Still another fact reveals itself that should not be left unmentioned, namely the detailed and careful study which is every day being made by scientific bodies, societies, clubs, churches, colleges and organizations of every description, of the whole problem of the relations between Capital and Labor or, perhaps better, between employer and employee. The conflicts which continue to rage between these two units of industry despite general business depression are so devastating that all, excepting perhaps the professional labor agitators, are realizing that the welfare of the whole world is at stake. Education is slowly awakening in the people the thought that industrial disputes, however remote, affect the entire community and not solely the particular combatants.

The committee also believes that, while the economic side of these questions must not be lost sight of, to attempt to solve the problems involved solely on the basis of economics will lead to failure. The human element must also be considered. Workers do not automatically obey economic laws even if the ultimate results follow such laws. They, however, do respond to treatment based on fundamentally sound sociological laws which are just as inexorable as economic laws.

The committee does not consider itself competent to lay down the conditions, minimum or maximum, which must be provided in order to obtain proper industrial relations, but it does recommend that those in charge of industrial relations lay down fundamental principles that will make for harmony and peace and not attempt to hide behind the pleas of economic laws and leave the relations between the employer and employee endangered by antagonism and misunderstanding.

The committee recommends that every engineer who may be in the position to aid his employer in these matters of industrial relations (or if he be the employer himself) make a careful study of the problem before jumping at conclusions. It recommends that the literature* on the subject be read thoroughly and the industrial conditions prevailing in the concern be studied most carefully. If it is found that coöperation and harmony between employer and employee is lacking, which results in dissatisfaction on either side or both, the employer should be urged to take the initiative in promptly terminating such conditions. This does not necessarily mean that elaborate employment and welfare departments must be installed. It does mean that in all cases the best methods should be employed to bring employer and employee closer together and create a spirit of mutual confidence in the organization which in turn will result in more efficient production for the employer and greater happiness for the worker.

## Cripples in Industry

By H. M. Wolflin, Chairman of Sub-committee

THE rehabilitation of industrial cripples has been actively inaugurated in the following states: California, Indiana, Massachusetts, Michigan, Minnesota, New Jersey, New York, Oregon, Pennsylvania and Wisconsin.

There are now two agencies in California directing rehabilitation work; namely, the Industrial Accident Commission and the State Board of Education. The former body deals only with injured employees, whereas the Board of Education provides training for disabled persons, whether or not they were the victims of industry. The State Board of Education started its work in September, 1921, under a state appropriation. The Industrial Accident Commission has given this board about 400 cases to handle. The last report of the

* A considerable bibliography on industrial relations is appended to this paper.

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Rehabilitation Department of the commission cites 22 completed cases. One case is described in this article as it pertains to the mining industry:

The subject of this sketch is an Italian. He was a miner, earning $21.49 a week. While at work, he fell 50 ft. to the bottom of a chute, fracturing the first and second lumbar vertebrae, resulting in paralysis of the lower extremities. He has no use of the right leg, but is able to stand on the left and gets around with crutches. The kidneys and bowels were involved also. He is entitled to compensation at $13.95 for 240 weeks and to a pension of $8.60 a week for the rest of his life under the 100 per cent. permanent disability rating given in his case. At the time of the injury he was 28 years old and had no dependents. During the four years he was in the hospital he learned to speak and write English and later repaired the clocks there and sharpened the surgeons' instruments. He became so interested in the work that he was encouraged to take a course in watch making and watch repairing. Now, after seven months training he is ready to qualify as a watch repairer and gives promise of being an expert. He expects to have a position in two weeks. Tuition, $155; supplies, $276.43; expenses, $310; total $741.43.

For 22 completed cases, the average cost was $203.24, and the average length of course was five months.

The rehabilitation of industrial cripples in California may be encouraged by the plan outlined in the following:

1. Adequate financial support for the Industrial Accident Commission, either through assessments from industries or by state appropriations.
2. Trained investigators to interview crippled workers and to encourage them to take vocational training courses.
3. A close coöperation between the permanent disability rating department and the rehabilitation department so that the investigators can reach the injured as soon as possible after an accident. All hospitals and the State Board of Health should send monthly reports to the rehabilitation department, giving full statements regarding all cases of industrial injuries.
4. Maintaining a placement bureau to secure positions for those who have received vocational training; also for others who have not received the training, but who have suffered an industrial injury.
5. An appeal to the public in order to give them some concrete facts regarding the rehabilitation work so that their support may be obtained. This may be done by means of motion pictures, literature, newspapers and other publicity agencies.

In New Jersey the activities of the clinic and the rehabilitation placement service are available to all citizens of the state more than 16 years of age, and it is the endeavor of the Rehabilitation Commission to make available its service to the largest number of citizens of the state. It would seem more reasonable to furnish a considerable degree of assistance to a large number of citizens than to expend the appropriation by providing extensive training for relatively few. While this work is new there, as it is in other states, it is felt that the success obtained has placed it upon a basis of the state's permanent activities.

The rehabilitation work of the State of New York is being done under the State Department of Education with offices in New York City, Albany, Syracuse, Rochester and Buffalo. Contracts have been made with about 1000 physically handicapped persons and something less than 100 have been started in courses of training, apart from those who have been assisted in various ways to return to gainful occupation. Only about one in five of the cases are suitable to be retrained in institutions, but a good deal can be done for many of the others to help them back to a self-supporting basis.

The Legislature of the State of Oregon in special session February, 1920, passed a Vocational Rehabilitation Act setting aside $100,000 from the State Industrial Accident Fund for the purpose of physical and vocational rehabilitation of men and women injured in the industries, with the intention of returning them to the industries. In addition to the $100,000 which was set aside, the law provides that 2½ per cent. of the funds received by the State Industrial Accident Commission of the State of Oregon shall be set aside and known as the rehabilitation fund.

Questionnaires were sent to injured persons and all those who signified a desire for retraining were interviewed; 400 have been interviewed and 140 placed in training. About 25 have successfully completed the work they started and about 20 of these are now either in business for themselves or working for some one.

The State of Michigan, by legislative act, 1921, accepted the provisions of the Federal Act for Rehabilitation. The State Board of Control for Vocational Education and the State Accident Board are to jointly carry on the work. A pamphlet, "The Michigan Plan for Vocational Rehabilitation," was issued in 1920, in which are outlined plans for carrying out the work.

Rehabilitation service in the State of Wisconsin was started Sept. 1, 1921. About 315 cases have been reported to the State Board for Vocational Education. Of this number, 238 have been investigated, 35 of which have been placed in training, 26 placed in industry and 6 classed as completed, either being dropped or referred to other states for attention.

## Conclusion

The foregoing serves to illustrate the fact that the country is being awakened to the importance of rehabilitating industrial cripples. Interest has been stimulated by the Federal act. A few states have entered the field and it is to be hoped that others will follow, and that the development will be even greater in scope and in rapidity than has been the development of workmen's compensation. Certainly the rehabilitation of an injured workman is no less important, in the ultimate analysis, than his compensation, and rehabilitation should be a recognized part of the compensation of every permanently injured employee.

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## Mental Factors in Industry

By Thomas T. Read, Chairman of Sub-committee

THE event of the year 1921 that was of most interest in personnel work was the organization of the Personnel Research Federation. The first annual meeting was held Nov. 21. The object, as stated in its constitution, is the correlation of research activities pertaining to personnel in industry, commerce, education, and government, wherever such researches are conducted in the spirit and with the methods of science. Its field of interest, of course, is much larger than that of this sub-committee, and yet the organization of the Federation is a direct outgrowth of the appointment of the sub-committee, which among its first activities set in motion forces that finally had their effect in the organization of the Personnel Research Federation.

This sub-committee was first appointed to consider the importance of mental hygiene in industry, especially in the mineral industry, and reports have been made year by year as to what was planned and what had been accomplished.

Boyd Fisher, who is well known in the field of personnel work, presented before the Annual Conference of the Massachusetts Society for Mental Hygiene (April 7, 1921) a paper entitled "Has Mental Hygiene a Practical Place in Industry?" Mr. Fisher quotes Dr. Stanley Cobb as stating that a reasonable application of psychiatry to industry would seem to be the following:

1. Physical examination of all applicants for work.
2. Mental examination by (*a*) a period of training and observation, or (*b*) through mental tests.
3. Keeping in touch with employees' individual problems by means of (*a*) good foremen, (*b*) a system for watching individual efficiency or (*c*) a sympathetic staff with a psychiatric point of view in the employment management office, thus salvaging the men who might otherwise be fired.
4. Training the industrial physician to a knowledge of how human nature is constituted, not in conventional terms, but in the light of a dynamic and living psychology.

After considering these topics Mr. Fisher makes the following suggestion: (1) that we consider for the present only the modern medical approach to the subject; (2) that we strive to clear up misconceptions on the subject of mental hygiene (3) that we recognize wherein we are already employing mental hygiene in industry; and (4) that we make a cautious approach toward a more scientific and technical direction of the work we are already doing. Mr. Fisher concludes "With all due cautions, however, and with all acknowledgments to the present state of understanding for the subject, mental hygiene has, in my opinion, a real and important place in industry and offers great promise of public service."

It is even more gratifying to be able to report that during the year the Shell Co., of California placed its employment department under the supervision of an industrial physician who is a psychiatrist, Dr. J. D. Ball.

I have not attempted to review the work done during the year by the group that I have previously described as measurers, since there is nothing especially notable to report and I infer that you prefer to be told of what is new, rather than to be informed of progress along lines already marked out. I cannot conclude, however, without some reference to the President's Conference on Unemployment, Sept. 26 to Oct. 13, 1921. The fear of unemployment is a very important mental problem of industry. It is a problem of such difficulty, however, that it is altogether unlikely that any simple or immediate solution will be found. That it is receiving so much consideration and thoughtful study is in itself cause for congratulation, and any progress which is made toward putting industry on a more stable basis (giving it a better power factor, in the phraseology of our craft), will accrue to the benefit of the whole public.

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## Prevention of Illness among Miners*

By R. R. Sayers, Chairman of Sub-committee

IT IS not the purpose of this report to try to describe all the work done during the past year for the improvement of health or the prevention of illness among miners, but to call attention to a few of the more outstanding investigations in which progress has been made. Among these, the investigations on the physiological effects of carbon monoxide, dust and ventilation, and temperature and humidity are discussed.

### Carbon Monoxide

During the years 1920 and 1921, much more work was done on the various phases of carbon monoxide than has been carried on for a number of years. A survey of carbon monoxide poisoning in the American steel works, metal mines, and coal mines was made by Dr. Henry S. Forbes, of the Harvard Medical School. He concludes from his survey that late after-symptoms following acute severe gassing rarely occur, and that almost always there is evidence of pre-existing pathological conditions when such effects do appear. He further states that he found no evidence of cumulative harmful effects resulting from frequent exposure.

The detection of carbon monoxide in air is so closely related to the prevention of illness due to that gas that the methods should be mentioned. There are two comparatively recent methods that have been developed. In the first, developed by French investigators, unsized paper is treated with palladium chloride solution, allowed to dry, and when needed is moistened. The white palladium chloride paper becomes grayish in color when exposed to as low concentration as one part of carbon monoxide in 3000 parts of air for five or six minutes. Hydrogen sulfide gives a reaction similar to that of carbon monoxide and must be removed by passing the air through lead acetate. The second method, developed in this country, is sufficiently sensitive to detect low concentrations of the gas in a few seconds. The detector chemicals are fuming

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sulfuric acid and iodine pentoxide on granular pumice in a sealed glass tube. The tips of the tube are broken just before using. The tube is then connected with a hand syringe by which a measured volume of air, freed from interfering gases, can be passed through the detector tube. A greenish color develops which is proportional to the concentration of the carbon monoxide in the air tested. By comparing this color with the scale an approximate quantitative determination may be made.

### Carbon Dioxide

For many years carbon dioxide has been discussed with reference to its relation to health. While it is a normal constituent of the air in very small percentages and is not a protoplasmic poison, carbon dioxide is a waste product of the body and as such, if it exists in sufficient concentration, has harmful physiological effects. The effects of breathing carbon dioxide in view of all data, are that, while it is possible to breathe 9 to 10 per cent. of carbon dioxide in oxygen, any percentage above 5 will cause noticeable effects, and between 2 and 2½ per cent. is all that should be permitted in the inspired air of an oxygen breathing apparatus at any time.

### Dust and Ventilation

Another subject which is of immense importance to the metal miner is the prevention of miners' phthisis and tuberculosis. It has long been recognized that the very fine dust from rock which has a conchoidal or needlelike fracture, especially silica or quartz, is apparently the most harmful. The extensive work of the South African investigators and that of Lanza, Higgins, and Harrington in this country is well known. These investigators emphasize the use of water in drilling and on muck piles, etc. However, it has been shown within the past year that unless the water is properly used it may not have the desired effect and the miners and operators will be working under a false sense of security. In South Africa, Orenstein and Ireland have come to the following conclusions from their studies:

1. Dust is not alone the cause of phthisis.
2. Ventilation does not increase the harmful dust conditions.
3. Exhausting air through the pipes from drives and winzes is much better than forcing air in through similar pipes.
4. Measurement of air currents and notes of any changes in velocity and direction in every section is absolutely necessary.
5. Air in stopes should be induced to flow along the face and not back in the open waste.
6. While eddies caused by local circulation may be helpful, such circulation can only be helpful for a limited time and as a temporary measure.

### Temperature and Humidity.

Harrington and Lanza have also called attention to the possible relationship between illness among miners and stagnant air which led to a study of the possible harmful effects of high temperature and humidity in mines. This work was carried out by Sayers and Harrington and in a preliminary report they summarize their studies as follows:

1. In still air, with wet bulb temperatures of from 85° F. to 86° F. and a relative humidity of 96 per cent., there were no marked changes in the blood pressure or body temperature, nor were the symptoms, dizziness, physical weakness, and inability to think or act quickly, found as long as the subjects remained at rest or took only light exercise. When moderate exercise was taken—climbing up and down an 8-ft. ladder 15 times in 5 min.—the blood pressure and body temperature rose somewhat.
2. Blood-pressure readings taken after the subject had reached the cool air of the surfaces were found to vary considerably with men unaccustomed to high temperatures. Under conditions which resulted in a rise of body temperature to 100° F., or more, the systolic pressure fell, but where the conditions were such as not to cause the body temperature to rise above 100° F., there was a rise in the systolic pressure when the subjects reached the surface. In one man, long accustomed to hot, humid air, a fall of systolic pressure was also found. In three others, not accustomed to the conditions mentioned, there was a rise of systolic pressure.
3. It was found that the body temperatures reached normal in from one to two hours after the subjects had reached the cool air of the surface after having been subjected to conditions that caused a rise above 100° F.

Sayers and Harrington have continued their studies, particularly noting the effect of air movement, and have found that, if the air temperature is above 75° F. and the relative humidity high, the efficiency and comfort of a worker are materially increased by air movement. With a linear movement of 100 ft., a miner is comfortable and fairly efficient so long as the temperature is not above 85° wet bulb. The same is true when the temperature is between 85° and 90°, provided the air velocity is 200 to 300 linear feet per minute. With a temperature of 90° to 95° the air is very oppressive when still but is not especially so when it has a movement of 400 to 800 linear feet per minute.

A very exhaustive study on the science of ventilation has been published by Dr. Leonard Hill. This study is far too extensive to be reviewed in this paper, but it contains a great deal of valuable information on all phases of the effects of atmosphere on man. Doctor Hill has devised an instrument, known as the katathermometer, which is really an alcohol thermometer with a large bulb, that records millicalories of cooling power per square centimeter of surface. The dry bulb records the cooling power due to convection and radiation, while the wet bulb also includes the cooling power due to evaporation. The possibilities of the usefulness of this instrument are very great and it deserves further consideration.

This committee realizes that it has only touched the literature on the subject of ventilation, and that there is yet much to be learned. That this is true is indicated by the fact that the U. S. Bureau of Mines, the U. S. Public Health Service, the American Society of Heating and Ventilating Engineers, the National Research

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Council, and coöperating universities are now engaged in extensive laboratory studies to try to formulate definite standards of temperature, humidity, and air movement to maintain health, efficiency, and comfort of workers.

## Housing and Recreation

By B. Britton Gottsberger, Chairman of Sub-committee

IN THE early stages of most mining enterprises, there is a large element of risk involved for the capital invested and this risk must necessarily be paralleled by a certain amount of hardship for the men employed. For many small mines, where the ultimate profit to be realized is of small present worth, a large investment to care for the human factor will never be justified and such operations must depend for labor supply on a class of labor largely made up of single men and those who prefer a wandering existence. Modern developments in mining are more and more tending to the opening up of extensive deposits to be operated intensively on a large scale. When the prospecting and development period of such enterprises has been passed, and an assured future has been demonstrated, it will be more and more the part of wisdom for the operators to include in their original capital requirements an amount necessary to make the beginning at least of a well worked out community plan.

Due to the fact that mining properties usually result in the growth of small isolated communities, it is extremely difficult for a mining company to handle this question and still avoid an undue element of paternalism. As large a degree of separation between a man's working life and his home and community life as circumstances permit should be provided for. Possible accusation of the exercise of paternalism should be faced in the beginning and deliberate steps should be taken to minimize it as far as possible. The formation of a separate corporation operating along the lines of a building and loan association, the management of which, under competent direction, would be placed as far as possible in the hands of workmen themselves, might be one means of attaining the desired end. The main point would be to divorce the management of the working operations of the company from the community interests of the men so that they would not feel themselves constantly under company supervision.

The study of such questions and the importance of solving them is certainly a large part of the new development in management called human engineering. It is not to be expected that technical engineers would attempt the detailed solution of such problems. It is, however, of the utmost importance that every engineer concerned with the technical management of industry should realize the importance to himself and to his operations of a contented working force, as far as such may be looked for or expected.

This committee has not attempted to outline the progress so far made by mining companies along the line of housing and recreation. It would plead, however, that the Institute through its membership do all possible to lend sympathy and support to the growth of the movement which recognizes that a workman is important as a member of his community and not alone as an employee of a company.

## Preservation of Natural Scenery and Attractiveness of Mining Camps*

By George F. Kunz, New York, N. Y.

MANY mines are situated in the most beautiful part of the world, in regions it has taken countless ages of Nature's activity to bring to their present conditions. Would it not therefore be eminently desirable that those in charge should do all they can to preserve, and even to develop, these natural beauties, so that natural aspects of great beauty may not become scenes of thoughtless devastation? The American Scenic and Historic Preservation Society earnestly suggests that this policy be pursued.

Another consideration, and one of at least equal importance, is that the cabins and homes of the miners be made attractive to the eye as well as comfortable as places of abode. Especially necessary are the preservation and the cultivation of trees in the immediate neighborhood of these dwellings, for if trees are ruthlessly destroyed a lifetime often is required to replace them. By the exercise of a little care in these respects, it would be possible, almost without expense, to render the miners' lives more restful and pleasant, and this would assuredly serve to make them more contented and better citizens.

It would be an easy matter to have little garden patches in the vicinity of the dwellings, and to provide the miners with the opportunity to cultivate these gardens in part of their spare time, which would serve as an elevating influence in their lives, and would help them to resist the depressing effects of constant toil under hard conditions.

The writer does not suggest laying out expensive parks, or other additional expense, but would remove unsightly and useless obstructions. Where there are reduction works, often it is impossible to make things grow, and such really necessary obstacles, of course, would be accepted and counted upon, but in most cases a regularization of operations will greatly aid in the development here advocated. There should be no planless scattering of the material derived from excavations; roads could be made to converge at a certain point, the ribble could be levelled out there and made into a series of platforms, which would make splendid foundations for buildings.

* Presented at the February Meeting of the Industrial Relations Committee.

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If suitable prizes were offered for designs of miners' dwellings, the execution of which would not entail any greater cost than that of the poor structures now built, it might prove a helpful factor in the elevation of the standard of living. Indeed, with proper care and foresight, these more attractive cabins might be put up at even less expense than is required for those now erected.

## Ground Movement and Subsidence

By George S. Rice, Secretary of Committee

THE Ground Movement and Subsidence Committee of the Institute, of which H. G. Moulton is chairman, held a meeting at the time of the annual meeting in New York, Feb. 20, 1922. There were present: Howard N. Eavenson, J. Parke Channing, William Kelly, F. W. McNair, F. W. Sperr, H. H. Stoek, J. W. Paul, E. A. Holbrook, and R. Dawson Hall; Lieut. Phil J. Weiss who represented the Navy Alaskan Coal Commission and George S. Rice, secretary of the committee.

The secretary made a report of progress of the committee's activities during the year, of which the following is an abstract:

Mr. Eavenson conducted subsidence studies at certain mines in West Virginia, Pennsylvania, and Maryland. Mr. Rice described investigations that had come under his observation in Illinois where a subsidence study in typical districts is being carried on by the U. S. Bureau of Mines, the Mining Department of the University of Illinois, and the Illinois Geological Survey. This investigation is still continuing and is now in charge of Dr. J. J. Rutledge, a member of the Institute, who submitted an abstract of a paper dealing with the subject. The secretary, referring to his recent visit to the anthracite district of Pennsylvania, in a mine cave matter, expressed the hope that some reports may be forthcoming from members of the Institute in that district, when so much valuable information on this subject can be obtained. Professor Probert reported that he was having a bibliography prepared supplemental to the publication of Prof. L. E. Young of the University of Illinois. The secretary also reported a visit to one of the mines of the Penn Iron Mining Co. and the securing of valuable data from William Kelly, a member of the committee, which it was expected would be prepared as a report for publication. The case was one of greatest interest as drill holes were put down to determine the extent of the ground movement. L. S. Cates, member of the committee, had submitted data concerning the Utah Copper Company's great open-cut operation in Bingham Canyon, and invited the committee to make suggestions relative to the methods of determining maximum slopes which might be adopted in open-cut work, this being a question of the greatest importance in such large-scale operation, inasmuch as it affects the recovery of additional ore reserves. The secretary also submitted with his report a proposed classification or grouping of the work of the committee based on the different physical situations and conditions of the mineral beds, deposits, and veins affecting the selection of methods of mining and, in turn, the character of the ground movement and subsidence from such mining.

### Principal Points of Discussion at Conference

Following a reference made by the chairman to the ground movement in one of Mr. Kelly's mines at Vulcan, Mich., referred to in the secretary's report, where consideration had been given to the possibilities of the ground spalling off over the mine excavation and ultimately filling the void through the broken rock occupying more space, Mr. Sperr said: "I have seen subsidence stopped by arching or by a stratum of strong rock, but never through filling up underneath," but added that he would be interested in studying this further by means of models.

An abstract was read by Professor Stoek of a paper by Messrs. J. J. Rutledge and C. A. Herbert on subsidence from longwall mining in northern Illinois where two mines effected a junction with one another under a brick high-school building. Lines of monuments had been established under a coöperation of the U. S. Bureau of Mines, the Mining Department of the University of Illinois, the Illinois Geological Survey, and the Spring Valley Coal Co. The coal bed is about 3 ft. 6 in. thick, the excavations are more or less filled with broken rock, and pack walls are built along the roadways. As the longwall face advanced, the subsidence took place more or less uniformly: over one face at the rate of 0.09 ft. per month for approximately 16 months and over another face about 0.12 ft. per month over a period of 8 months. The final subsidence was about 2 ft. in one case and 1.6 ft. in another case. The former required a period of three years and four months to become completely at rest and the latter required approximately two years from the time the monuments were first affected until subsidence had ceased. The two-story brick high-school building had concrete foundations which were reinforced. As the faces approached, cracks began to show in the brickwork; none were observable in the concrete foundation. When settlement had been completed, practically all of the cracks had closed. The total subsidence of the northwest corner was 1.614 and at the northeast corner 2.044; this difference in the amount of settling, 0.43, Mr. Rutledge ascribes to lateral movement and compression of sands under the foundations at certain points.

Mr. Eavenson read a paper regarding subsidence from mining in the Uniontown district working a 7 to 8-ft. coal bed. The greatest amount of subsidence was from 3½ to 4 feet.

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Following the discussion of Mr. Cates' problem at Bingham Canyon, Mr. Holbrook asked whether the problem was not one of sliding materials rather than subsidence and therefore a problem of civil engineering. The chairman said that the points of view of the civil engineer and the mining engineer are different; usually the civil engineer's viewpoint is that of a permanent structure and the mining engineer's is often that of a temporary condition until the ore has been excavated. Mr. Channing said that even if it was a problem of civil engineering, it was of interest to the mining engineer, as he had such a problem at Miami in connection with a tailing pile. They are now very careful to make the pile with coarser material in front, which forms the slope and allows the finer material to flow back and be deposited at the upper end of the gulches as far from the front as possible.

Mr. Channing also described the action at Miami where in undercutting a capping of the orebody they suddenly experienced a great fall which brought down the whole area with a rush. This was probably due to a vertical fault or slip to which attention had been directed by Mr. Moulton.

Mr. Eavenson described studies that he had made in connection with the Sewickley seam near Uniontown which overlies the Pittsburgh bed, the coal of which was mined out years ago. It was found that there was no material disturbance in the upper bed. The worst feature encountered was gas which had worked up into the upper bed. In some places the floor dropped a little but was safe to work. In some places where work had been begun in the upper bed before they had stopped working in the lower bed, it was found dangerous to work the upper bed at the same time, but a lapse of six months between the time they stopped work in the lower bed and beginning on the upper was sufficient to eliminate danger. The chairman spoke of a similar case he had observed in the anthracite district, where an upper bed was being mined without difficulty, although mining in the lower beds had produced a drop of 10 ft. at the surface. Mr. Eavenson said that at the Turkey Gap mine, West Virginia, the old mine in the thick Pocahontas bed has been completely mined out and they are now mining in a bed 350 ft. above this; they have found no trouble except that the coal is very wet, which indicates that the cracks from mining the lower bed have gone clear up to the surface.

Mr. Hall said he thought that Professor Sperr was in error in stating that the first break is as an arch, then vertical, and then sloping backward from the excavation. The fact that the roof in underground excavations breaks in its underside in the form of an arch is not evidence of the existence of a real arch, although an arching effect may contemporaneously exist. He believes that the action was due to a cantilever effect of the rocks acting as beams, resting on the edges of the coal. He stated that "the break over the solid arises from bending moment," and cited a cantilever bridge which always has the most metal over the piers because of the strain at that point. "The position of the first break determines the position of the final crack down to the coal" (referring to longwall workings). Mr. Hall illustrated his remarks by sketches in which he pictured a theoretical section at the face of a longwall mine with the overlying stratum shown as a series of lapping cantilever beams fulcruming over the edge of the solid coal and producing "a draw" at the surface 70° or thereabouts (from horizontal) in advance of the excavation.

A mimeographed copy of the minutes of the meeting has been submitted to the members of the committee and a certain number of copies are available to other members of the Institute.

## Research Fellowships

THE following fellowships are open to graduates of universities and engineering schools who are qualified to undertake the research investigations outlined.

### University of Alabama

The School of Mines of the College of Engineering of the University of Alabama offers five fellowships in Mining and Metallurgical Research in coöperation with the U. S. Bureau of Mines. The value of each fellowship is $540 per year of nine months beginning Sept. 1. The research consists primarily of laboratory work, directed by the Bureau of Mines technologists and the School of Mines staff. The following problems have been selected for investigation for the year 1922–1923: beneficiation of iron ores; preparation, treatment and uses of non-metallic minerals, such as clay, barite, etc., in the industries other than the ceramic and chemical industries; metallurgical coke.

Applications are due on July 15. For further information, address H. D. Pallister, Professor of Mining Engineering, School of Mines, University, Alabama.

### University of Washington

The College of Mines of the University of Washington offers five fellowships for research in mining, metallurgy, and ceramics in coöperative work with the Bureau of Mines. The value of each fellowship is $780 per year of 12 months, beginning July 1. The investigations consist principally of laboratory work directed largely by the Bureau's technologists. For the year 1922–1923 the following subjects have been selected for investigation: beneficiation of coal, especially coal washing; electrometallurgy—electrothermic and electrolytic treatment of various mineral resources; ceramics—survey and testing of the ceramic resources of the Northwest.

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Applicants should send a copy of their collegiate records from the Registrar's office of the college where they have been, or will be, graduated. They should also state in detail their professional experience, and give the names and addresses of at least three persons who are familiar with their character, training and ability. Applications are due on June 10 and should be addressed to the Dean, College of Mines, Seattle, Washington.

CARNEGIE INSTITUTE OF TECHNOLOGY

The Coöperative Department of Mining Engineering of Carnegie Institute of Technology, Pittsburgh, announces two fellowships in mining research and two in teaching and research, in coöperation with the Pittsburgh Experiment Station of the United States Bureau of Mines. The value of each fellowship is $750 per year of ten months, beginning July 1 for the position of Research Fellow and Aug. 1 for Teaching Fellow.

Investigations will be on acid mine waters; shooting coal; spontaneous combustion and coal storage; geology of coal; byproduct coking; utilization of coal; determining the compressive strength of coal from various beds.

The Research Fellow is to devote all his time to work in the Experimental Station of the U. S. Bureau of Mines, the Teaching Fellow will give 10 hr. each week to teaching mining, and the remainder to work in the Experimental Station.

## Silver Producers are Receiving No Bounty

JOHN PARKE YOUNG, Princeton economist, in *American Bankers' Association Journal*, criticises the Government for buying silver at $1 an ounce when the market price is only 65 cents, which he terms an annual subsidy of $73,000,000 for the silver mines, a special bounty for which there appears no valid reason. At rate of purchase since May, 1920, when buying started, it will be over two years before authorized 209,000,000 oz. are bought; up to May 9, 96,000,000 oz. had been bought. Hence there would be a saving of $113,000,000 if purchases were discontinued. Professor Young would do well to read Mr. Kelley's article in MINING AND METALLURGY of November, 1921, and also take note of the fact that Great Britain is now repaying the United States Government for the silver that was released to it with the consent of the American producers.

## Need of Maps Emphasized

EXPENDITURES that would be needless if there were maps available are made every year to an amount that would pay for the complete mapping of this country, according to a statement written by F. W. DeWolf, chief of the State Geological Survey of Illinois, for the American Engineering Council. Mr. DeWolf urges the immediate passage of the Temple Bill, which authorizes the mapping of the United States within the next 20 years, and asserts that the popular cry for economy, which will be the chief obstacle to its passage, will be misleading.

In July, 1919, Engineering Council brought to the attention of the President the need for a coördinated program of Government mapping agencies; a Board of Surveys and Maps was created from representatives of Government departments, and an advisory council of non-Federal map-using agencies was appointed to assist the board. It was proposed that increased appropriations be made by Congress and by the states for a coöperative program which would complete the work in 13 years, instead of the 80 or 100 years necessary according to recent progress. The Temple Bill covers these recommendations. It was introduced in the House of Representatives in April, 1921, by Congressman Temple of Pennsylvania and is known as H. R. 5230.

Mr. DeWolf says that the states and the Federal Government are committed to a rapid building of main trunk highways, and are spending millions of dollars each year on actual construction, besides hundreds of thousands on related engineering work involving surveys, and that these would be eliminated or reduced to a minimum if standard topographic maps were available in advance. Highway engineers of dozens of states have estimated the value of topographic maps in their work, and as a result it can be concluded that the cost of mapping the country will be justified by the saving in road surveys and engineering computations.

The removal of surplus water from fertile lands in valleys and swamps is also important, but before such work can be intelligently planned, financed, and undertaken in any large area it is necessary to have surveys showing the catchment area, the slope of the ground, the fall of the stream, and related information. Other problems are those of municipal water supply and sewage disposal, location of barge canals, feeders and impounding reservoirs.

Topographic maps made by the Government in coöperation with the states, counties, or other municipal corporations offer the best preliminary form of fundamental information and at the same time contribute to the general program of mapping the United States.

## Industrial Engineering

THE Influence of Industrial Engineering on the Earnings of Capital and Labor was the major subject of the eighth national convention of the Society of Industrial Engineers, at Detroit, April 26–28. Sessions were held by groups devoted to production, education, industrial relations, managing executives, sales management, and accounting. Speakers included Joseph W. Roe, president of the society; Mayor James Couzens, and Mortimer E. Cooley, president of the Federated American Engineering Societies.

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# Abstracts of Institute Papers

The following papers will be printed in full in pamphlet form.
A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 20 of the Advertising Section. Discussion of papers is invited.

## Oil Possibilities in Brazil*

By John C. Branner,† Stanford University, Cal.

FIVE of the geologic horizons that yield oil in other parts of the world are represented in Brazil; namely, the Devonian, Carboniferous, Permian, Cretaceous, and Tertiary. Thus far, the first two have shown no evidences of being oil bearing within Brazilian territory. Not enough exploring has been done to permit trustworthy comparisons of the relative importance of the Permian, Cretaceous, and Tertiary as oil-bearing horizons in this country. The most important, indeed almost the only, information available relates to the locations of the areas and to the structural features of the several horizons. The theories regarding the physical conditions under which these rocks were laid down, however, I regard of the utmost importance.

### Permian

Rocks of Permian age cover an enormous area in Brazil, extending from Rio Grande do Sul to Maranhão on the north; and to Matto Grosso on the west. These Permian rocks in many places are known to include oil-bearing shales and in some locations contain small veins of gilsonite.

Indications of oil have been found in the state of São Paulo, Paraná, and elsewhere farther south, but wells drilled in the Permian of São Paulo near the Morro do Bofete did not find oil. One well has been started, by the Brazilian Government, in the Permian of Paraná near Marechal Mallet, close to latitude 26° south, but thus far oil has not been found.

### Cretaceous

Rocks of Cretaceous age are found in many Brazilian states, but while some of them are certainly of marine origin, others seem to be land and fresh-water deposits. Those best known are the marine beds in the states of Sergipe and Bahia, where they are more or less folded and exhibit what petroleum geologists consider favorable structure. In some places, especially at Marahú in Bahia, marine Cretaceous beds are accompanied and overlain by oil-bearing shales.

I know of no test walls having been drilled in the Cretaceous rocks in any part of Brazil. There has been talk of drilling such wells, but if any have been sunk, it is to be assumed that they were unsuccessful, as the results have not been reported.

### Tertiary

The chief Tertiary area of Brazil lies along the eastern base of the Andes, covering almost all of the Acre territory, the greater part of Amazonas, and forming broad belts across Pará on both sides of the Amazon river. This area is narrow and patchy along the rest of the east coast of Brazil from Maranhão, at the north, to Rio de Janeiro, on the south. In some places these coastal Tertiary beds are known to have Cretaceous rocks beneath them, but for the most part they rest upon Archean granites and gneisses. They are folded in some places but, for the most part, are nearly horizontal. The rocks are sandstones, shales, and conglomerates, and are greatly weathered and highly colored where they are exposed along streams and on seashores. They sometimes contain marine or brackish-water fossils, and the shales are often petroliferous.

Turning to the great Tertiary area of the Upper Amazon region, we are certainly not limited for room, for within Brazilian territory alone the Tertiary area, in Acre and Amazonas, covers more than 1,000,000 sq. km. The thickness of these deposits, except along the margins, is unknown. At many places they contain beds of lignite. Regarding this great area as an oil field we have but little more than opinions and theories. In 1908, I. C. White surmised that if large deposits of petroleum were found in Brazil they would "be located in the territory drained by the great Amazon;" but he does not say why he reached this conclusion. In 1920, Horace E. Williams, of the Geological Survey of Brazil, said that this same region "and the Peruvian frontier . . . seem to be the most promising field for explorations of any in the country."

I know of only one attempt to drill an oil well in the Tertiary area of Brazil and this was made in the state of Rio de Janeiro near Campos; it is said to have reached a depth of 30 m. without finding oil.

* New York Meeting, February, 1922. Since deceased.

## Oil Reserves of the United States*

By David White, Washington, D. C.

THE submission of carefully prepared estimates of the oil reserves of the United States calls for no apology nor explanation. In this country, petro-

* New York Meeting, February, 1922.

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leum is a rapidly wasting asset and an occasional appraisal of the amount remaining in the ground is a simple business procedure to safeguard the general welfare and the prosperity of the republic. The rumored danger of failure, in the near future, of the foreign supply on which we depend in constantly increasing amounts makes the immediate review of our available reserves the more imperative.

The Director of the U. S. Geological Survey, in March, 1921, requested the American Association of Petroleum Geologists to coöperate in the preparation of new estimates of the oil remaining in the ground. With the members of this coöperative committee, state geologists, regional geologists, consulting specialists, and geologists and engineers attached to many companies worked both independently and through subcommittees. The reports for districts, counties, fields, etc., after review by local or state committees, were discussed by the joint coöperative committee in conferences that, in some instances, were attended by the original compilers of estimates for the states or smaller areas. Finally the data were reviewed and the figures revised by the joint coöperative committee, so that the totals given in Table 1 represent the opinion of the committee, which was composed of F. W. DeWolf, W. E. Wrather, Roswell H. Johnson, Wallace A. Pratt, Alexander W. McCoy, Carl H. Beal, C. T. Lupton, G. C. Matson, K. C. Healld, W. T. Thom, Jr., A. E. Fath, Kirtley F. Mather, R. C. Moore, and David White, chairman.

TABLE 1.—*Estimated Oil Reserves of the United States, by States or Regions, January* 1, 1922

| | Millions of Barrels, of 42 Gallons |
|---|---|
| New York | 100 |
| Pennsylvania | 260 |
| West Virginia | 200 |
| Ohio | 190 |
| Indiana and Michigan | 70 |
| Illinois | 440 |
| Kentucky, Tennessee, northern Alabama, and northeastern Mississippi | 175 |
| Missouri, Iowa, North Dakota, Wisconsin, and Minnesota | 40 |
| Kansas | 425 |
| Oklahoma | 1,340 |
| Northern Louisiana and Arkansas | 525 |
| Texas, except Gulf coast | 670 |
| Gulf coast, Texas, and Louisiana | 2,100 |
| Colorado, New Mexico, and Arizona | 50 |
| Wyoming | 525 |
| Montana, Nebraska, and South Dakota | 100 |
| Utah, Nevada, Oregon, Washington, and Idaho | 80 |
| California | 1,850 |
| Eastern Gulf coastal plain and Atlantic coast states | 10 |
| | 9,150 |

Of these 9,150,000,000 bbl. of oil, over 4,000,000,000 bbl. are in the heavy-oil group, including fuel oils, and 5,000,000,000 bbl. in the light-oil classes. The Lima-Indiana field is credited with 40,000,000 bbl., and approximately 725,000,000 bbl. are believed to remain in the Appalachian states. These estimates relate to oil in the ground recoverable by present methods.

It may be of interest to note certain views of the committee:

1. The recovery of oil in commercial amounts can not be expected in areas where the rocks are metamorphic, igneous, or too far altered, as indicated by the stage of carbonization of the organic debris in the strata.

2. Fresh-water deposits, such as some of the Tertiary formations of the Great Basin and the Northwest, are not wholly without oil possibilities, though the attitude of the oil geologists in regard to such deposits is far from optimistic.

3. The Triassic of the Atlantic states is, on account of its generally strongly folded and sometimes shattered, condition, its general composition, and the data available as to its stage of alteration, given little value even in its deeper basins. For this reason as well as their widespread regional alteration, the New England states are practically excluded from the possible oil territory of the country, though it is conceded that conditions possibly favorable to oil may be found eventually in the Upper Paleozoic of a portion of northern Maine.

4. The absence, so far as at present known, of buckling of the Cretaceous and Tertiary formations of the Atlantic coastal plain into well-developed anticlines and domes, and the relative thinness of the aggregate post-Triassic deposits in most of this area offer little hope for appreciable amounts of oil in this great region.

5. The relative alteration of the Paleozoic beds of the Upper Peninsula of Michigan and of Minnesota, the restrictions as to thickness of the post-Paleozoic formations, and the apparent lack of folding in the latter exclude these regions from the possible oil territory of the country. On the other hand, the committee has considered and, in most cases, made allowances for possible occurrences of oil in older formations, including deeper sands than those now productive.

No estimate is submitted for Alaska, as to which recent geologic reports are in general very favorable.

Contrary to the statement that the oil reserves of the United States will be exhausted in 20 years, as has been erroneously reported, a long time will be required for the exhaustion of our oil fields. Though the estimated reserves would not survive 20 years if they could be made available so quickly as to meet the demands, even at the present rate of consumption.

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**Experiments** conducted by the Bureau of Mines to determine the effect of water vapor on the volatilization of zinc as metallic chlorides indicate that for a low percentage of zinc and high percentage of salt a much larger percentage of zinc is volatilized than when the percentages of salt are lower than those of zinc in the charge. Water saturated at 50° C. apparently has no effect on the volatilization as compared with dry air, the difference being in favor of dry air.

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## Petroleum Reserves of the West Indies*

By Arthur H. Redfield, Washington, D. C.

THE West Indies are the summits of a submerged mountain chain, the continuation of which must be sought in the mountains of central Honduras. In Haiti, the chain divides, one branch passing through Jamaica and the other through Cuba, the Cayman Islands, and the Misteriosa bank.

The prospective oil fields of the West Indies lie in the Great Antillean arc. The structure of these islands is generally anticlinal, though modified by faulting and igneous intrusion. Of the islands of this group Cuba, Haiti-Santo Domingo, and Barbados offer the greatest promise of oil reserves.

The structure of Porto Rico is not favorable for oil. A broad zone of the crystalline complex occupies the center of the island; Tertiary and Quaternary sediments occupy coastal areas of relatively minor extent. The structure of Jamaica is likewise unpromising.

The oldest rocks known on the island of Cuba are a complex of serpentines, granites, slates, and schists, unless we except two exposures of limestones of doubtful Paleozoic age, north of Trinidad, one in the province of Santa Clara and the other near the north coast of the island, crossing the border between Puerto Principe and Santiago Province. On this crystalline complex, which extends through the center of the island along its major axis, rest the later sediments. Jurassic limestones and altered shales form the crests of the Sierra de los Órganos and the Sierra del Rosario in the province of Pinar del Rio; this is the only exposure of sediments of early Mesozoic age in the West Indies.

The general structure of Cuba is geanticlinal. The older rocks, both sedimentary and igneous, crop out in a general way along the axis of the island; and the younger formations are exposed in irregular zones on both sides of this axis. The geanticline is asymmetric.

Asphalt seeps and veins or oil and gas seeps have been reported from every province in Cuba. They are most common on the north coast, especially in a zone about 20 mi. wide, between Esperanza and Santa Clara Province, and 475 mi. long. Most of the oil or asphalt seepages occur in fractured serpentine.

No serious attempt can be made to estimate the unmined petroleum reserves of Cuba until the geologic questions as to its origin and mode of occurrence are settled. No well drilled to date has passed through the serpentine, in which the seepages occur, so that the underlying structure is a matter of conjecture. Without more exact knowledge of the geologic occurrence of the oil, we cannot estimate even the extent of the probable oil-bearing formations. DeGolyer believes that oil still remains in the island, but that the prospects of developing a great oil field are not good, and that the hazards of prospecting are more than the average.

The most promising area in Haiti and Santo Domingo, from the standpoint of petroleum production, is the central structural depression of the island. This includes the Central Plain of Haiti, and the Valley of San Juan and the Azua Plain of the Dominican Republic. The oil-bearing horizon in the Azua Plain is a Miocene series of conglomerate, coarse sandstone and sandy shale. In Haiti, the most promising formation is considered to be the Thomonde formation (Lower Miocene) of shales, sandstones, conglomerates, and limestones. There are well authenticated reports of seepages in the Miocene beds of the Azua Plain. Reports of seepages in the Thomonde formation of Haiti have not been confirmed.

The structure of Barbados is complicated and the details are little known. The strata of the Scotland series are closely folded, considerably faulted, and much shattered. The area of Barbados is only 166 sq. mi., and the horizontal cover of limestones makes it impossible to ascertain how much of this limited area is underlain by the Scotland series. In view of all these circumstances, the petroleum reserves of Barbados may be considered to be insignificant in relation to the world situation.

On the whole, the West Indies (exclusive of Trinidad and Tobago) do not constitute a promising area of oil reserves. Most of the islands present unfavorable structures or composition. The smaller islands, with the exception of Barbados, are composed of late eruptive rocks or of flat-lying Upper Tertiary sediments. Of the Greater Antilles, only Cuba and Haiti-San Domingo appear to have the proper geologic structure for the accumulation of commercial pools of oil.

* New York Meeting, February, 1922.

## Oil Possibilities of Colombia*

By Chester W. Washburne and K. D. White

COLOMBIA has an almost ideal situation with respect to the world's markets. It is only a short distance from the Panama canal, and the West Indies and the sailing distance from its Carribbean ports to New York in less than that from Tampico.

Geographically, Colombia consists of three systems of broad mountain ranges separated by two long narrow valleys. The Cauca River valley separates the Western or Coastal range from the Central range. On the west side of the Coastal range are the Atrato and San Juan Rivers. The Central and Eastern ranges are separated by the Magdalena River valley. In the department of Santander, the Eastern range divides, one branch continuing northward as the Cordillera of Perija, the other turning eastward across Venezuela as the Cordillera of Merida. Between these ranges is the great basin occupied by Lake Maracaibo.

These valleys consist mainly of long narrow reëntrants or tongues of Tertiary sediments between the older rocks of the mountain ranges. The late Miocene and

* New York Meeting, February, 1922.

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younger sediments seem to have been deposited in separated basins, but the Cretaceous and possibly some earlier Tertiary strata were laid down more or less continuously over a great part of Colombia and Venezuela. These strata were subsequently folded into the present ranges. The deposition of the Cretaceous and of some of the Tertiary was in a great sea, the main land-mass being in Brazil, with land probably along some of the cores of the present mountain systems. The sediments, except the Lower Cretaceous, vary markedly in character and thickness. An illustration is seen in the massive series of non-marine conglomerates and sandstones of the upper Magdalena River valley, near Honda, which are almost wholly wanting in the coastal sections where marine sediments prevail.

The oldest rocks bearing on the search for oil are the black carbonaceous and bituminous shales, limestones, and cherts of the upper part of the Lower Cretaceous. These probably are the main source of oil in both Colombia and Venezuela. They include thick bodies of true "oil-shale." Above the carbonaceous and bituminous beds, lies a series of many thousand feet of clastic sediments. The most noticeable and easily recognizable formation among these clastic sediments is the "coal-bearing series," which may be either upper Cretaceous or Eocene. The horizons that have been proved to be petroleum producers in Colombia occur in this series and in the next overlying formation.

The several stratigraphic sections available for Colombia are platted in an accompanying illustration, with tentative correlation lines drawn between formations which are thought to be nearly contemporaneous.

The sediments of the Sinu River Valley are of Miocene and Pliocene age, in large part marine. Elfred Beck describes several structures which he located east and north of the Sinu River, the most important being the Sincelejo anticline. The eastern flank of the anticline dips from 5° to 30° while the western limb dips at 45°.

The petroleum evidence of the Sinu River Valley district consists of seepages of heavy tarry oils, dark green oils, gas springs, and mud volcanoes. Practically all oil and gas seepages are located either in the fractured core of closely folded anticlines or along fault planes. Four wells have been drilled and another is now being drilled.

The Cartagena-Barranquilla Coastal area roughly embraces the region between the Carribbean sea coast, the Magdalena River, and the Cartegena-Calmar railroad. In this territory about as many wells have been drilled as in all the rest of Colombia.

About 6 mi. southwest of Puerto Colombia, at the village of Perdices, seven wells had been drilled up to the beginning of 1918, all within 1000 ft. of each other. An eighth well is located about 3 mi. east of this locality.

Of these eight wells, the deepest, No. 6, Perdices, was drilled to 3030 ft. This well encountered showings of oil and gas at various horizons, and at 2443 to 2446 ft. in a sandstone, 3,000,000 cu. ft. of gas was reported. Well No. 1, Perdices, had the best showing; salt water and oil, with a gravity of 32° Be., were reported at 135 ft. while in a broken sand and shale formation at 745–754 ft., oil of 43.4° Be., which flowed naturally and on the pump made 140 bbl. in 7 hr., was reported. In 1917 the well was badly mudded but pumped about ½ bbl. a day. The other wells which were drilled to depths of 1600 ft. or less encountered shows of oil and gas.

The surface evidences of petroleum in this district are large, active mud volcanoes, gas springs, and seepages of dark green oil. Unfortunately, none of the drilling seems to have been on large, well formed structures. The drilling on suitable structures in this region seems to be amply justified.

The Lower Magdalena River Valley is one of the two areas that have been proved to contain commercial oil deposits. The field is about 300 mi. from the mouth of the Magdalena River, and 20 to 25 miles eastward, up the Colorado River. The discovery well was drilled in April, 1918, by the Tropical Oil Co., after abandoning the first two wells, at about 600 ft., owing to great difficulty with caving. Of the three producing wells, No. 1., drilled 2300 ft., was good for 3500 bbl.; No. 2, drilled 700 ft., 700 bbl.; No. 3, drilled 1500 ft., 1500 bbl. The gravity of the oil was between 42° and 45° Be. The company was purchased in 1920 by the Standard Oil Co. of New Jersey, which has built a railroad from Barranca Bermejo to the field and has shipped in large supplies of pipe, casing, tools, etc., preparatory to extensive developments.

In this region there are large deposits of asphalt or brea, active seepages of dark green oil, gas springs, and veins of devolatilized asphaltum varying from gilsonite to grahamite. Here the large deposits of asphalt and hydrocarbon veins are restricted to the east side of the valley.

Since the occurrence of oil in commercial quantity is now proved, one should test any structure that is not too contorted, under which the drill can reach the coal-bearing series of strata just above it.

The Upper Magdalena River Valley refers to the region above La Dorada, the head of navigation of the lower Magdalena. It includes the Honda district, where recently there has been considerable leasing and some drilling.

The region has numerous small anticlines. Its major structure is a series of great north-south block-faults, the throw of some of these being many thousands of feet. There are two main lines of seepages. One is along the east side of the Magdalena valley, or the west foot of the second range of the Eastern Andes, locally called the Cordillera de Sargento; the other follows the west side of the valley, or the east foot of the Central Andes. Most of the seepages below Guataqui consist of heavy asphaltic oil or brea, while most of those above Guataqui consist of dark green oil, but exceptions occur.

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# Personal Notes and Biographies

## Henry Marion Howe

HENRY MARION HOWE died at his residence in Bedford, N. Y., on May 14, 1922, of a malady from which he had been suffering for more than fifteen months.

Doctor Howe was prominently identified with the Institute, which was the first technical society he joined, and in which he held office at several different times, from 1879, when he was vice-president, to 1893, when he served as president.

He was a loyal and active member of the Iron and Steel Committee, and did more than any one else to enrich the publications of the Institute in the field of iron and steel metallurgy. At the meeting of the directors on May 19, the following resolution was passed:

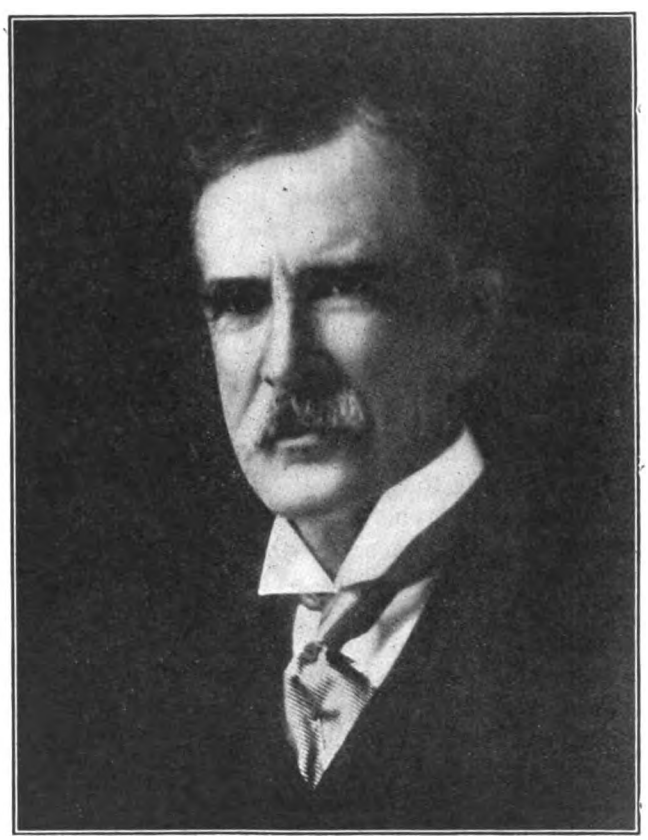
The Directors of the American Institute of Mining and Metallurgical Engineers place upon record their profound sorrow at the death, on May 14, 1922, of Past President Henry Marion Howe. Mingled with their regret at his loss is their realization that the honor and credit reflected upon the Institute by the eminent attainments of their Past President, the acknowledged leader among the scientific men of the world who have collaborated in developing the science of the structure and properties of iron and steel, is an undying memory in which the Institute and its members may justly take pride, even though the distinguished author is no longer in their midst.

The Directors are happy to record that Doctor Howe used this Institute as the principal means of distributing to the world the results of his great work in research, investigation and interpretation. He was loyally devoted to the Institute; he joined it the year that he graduated from college, which was also the first year of the Institute's life; he was a frequent attendant at the conventions in all parts of the country, and enriched the TRANSACTIONS not only by his original contributions but by his constructive and valuable discussions of the papers of others, and by his skill as a presiding officer at many of the sessions. Eminent son of eminent and distinguished parents; possessor of a mind greater than that of most men for its ability to grasp scientific truth and interpret the results of investigation; gifted with a command of the English language which was equaled by few men of his time; expert organizer of research; the American and foreign engineering societies, universities and governments have honored you as few engineers have been honored, and you in return have reflected honor upon them by your membership and your contributions.

IT IS RESOLVED, That this minute be spread upon the records of the Institute, be published in the magazine, and be sent to the family of our honored colleague.

A record of Doctor Howe's professional career, of his principal published works, of his more than three hundred technical monographs, and a very long list of the honors conferred on him by American and foreign technical societies, governments and universities, was given in the Bulletin of the Institute for July, 1917, in connection with the award of the John Fritz Medal to Doctor Howe on May 10, 1917.

On that occasion, Dr. Rossiter W. Raymond, in his address, spoke of Doctor Howe and his professional achievements in part as follows:



HENRY MARION HOWE

"Henry Marion Howe was born March 2, 1848, at Boston, Mass. His father was Dr. Samuel G. Howe, famous for his service to Greece in her war for independence (from 1824 to 1830) and later for his labors in the instruction of the blind. His mother was Julia Ward Howe, author of the Battle Hymn of the Republic, and leader in many reforms. It was a good stock on both sides, making him heir to intellectual keenness and refinement, the capacity for both enthusiasm and perseverance, a passion for the pursuit of knowledge, and a gift of clear and felicitous statement.

"This inheritance was improved by a liberal education . . . . We may be sure that Professor Howe's

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easy command of his field in technical literature owes much to the circumstance that he was graduated in 1865 from the famous Boston Latin School, and, four years later, received his degree of Bachelor of Arts from Harvard College. Thus equipped, he entered the Massachusetts Institute of Technology, which gave him in 1871 the degree of 'Graduate in the Department of Geology and Mining Engineering'—a cumbrous title for which the institution substituted, a few years later, that of 'Bachelor of Science.' Harvard made him Master of Arts in 1872, and Doctor of Laws in 1905. But upon this basis of wide and liberal culture, it was necessary to his future achievements that he should lay another foundation of acquaintance with practice; and this he did during the next dozen years, as a student in the steel works at Troy, manager of works at Pittsburgh, and designer and builder of the works of the Orford Nickel and Copper Co. at Capelton and Eustis in the province of Quebec, and at Bergen Point, New Jersey. His experience in the metallurgy of copper bore legitimate fruit in the publication at a later period of his first book, "Copper-Smelting;" but before this appeared (in 1885), he had already become known through his technical papers as an acute observer and reasoner, by no means averse to friendly controversy.

"Since it is my present duty to offer, not so much a symmetrical and complete account of Professor Howe's activities as a description of the particular labors in recognition of which he receives today from his brother engineers the John Fritz gold medal, I shall pass lightly over the general features of his career, merely observing that from 1883 to 1897 he resided at Boston, and, besides his private practice as a consulting metallurgist and expert witness in metallurgical patent suits, was lecturer on metallurgy at the Massachusetts Institute of Technology; that in 1897 he was called to the professorship of metallurgy in Columbia University, from which position he retired in 1913 with the title of Professor Emeritus; and that for the last ten years he has declined as far as practicable all professional business, in order to devote himself exclusively to the completion of what had clearly become the great scientific mission of his life. To this end, he has maintained at his own expense a special laboratory of research.

"It gives me pleasure to fancy, whether or no the fancy be also fact, that I remember the beginning of that mission, forty-odd years ago. In 1871, the first year of the existence of the American Institute of Mining Engineers, Mr. Howe, then just graduated from the Massachusetts Institute of Technology, became a member of the new organization. His two earliest contributions to its TRANSACTIONS, Blast-Furnace Economy, in Vol. III, and Thoughts on the Thermic Curves of Blast-Furnaces, in Vol. V, indicated already that he was making a scientific study of practice. But between the dates of these papers a famous controversy was inaugurated in the forum of the Institute by the brilliant paper of Alexander L. Holley, *primus inter pares*, entitled "What is Steel?" In this controversy, eminent metallurgists like Wedding, chemists like Prime, and expert captains of industry like Metcalf, vigorously took part; but of all the knights of the tourney, none rode a straighter course or laid in rest a sharper lance than Howe, whose paper on The Nomenclature of Iron ardently advocated a scientific as distinguished from a commercial nomenclature.

"The science of metallography, at least so far as it relates to iron and steel, may be said to have begun with the observations of Sorby on the microstructure of iron, reported in 1864 and 1868. Martens published independently in 1878. But already in 1868, Tschernoff had enunciated the chief laws that govern the metallography of iron. These were supplemented by the appearance in *Stahl und Eisen*, 1885, of Brinell's laws. All these creditable steps of progress were rendered more or less uncertain and incomplete by the imperfection of the apparatus and methods of precision, by consequent errors of observation, and by gaps in the data—though the aggregate quantity of material was already overwhelming. Then came, in 1887, and subsequent years, the remarkable investigations and intuitions of Floris Osmond, who discovered that metals frequently combine to form definite chemical compounds, and that these compounds frequently form solid solutions. He discovered also the thermal critical points of iron, and, interpreting these changes in the cooling-curve as indications of some molecular change, propounded the brilliant hypothesis of the allotropy of iron which furnished the acceptable allotropic theory of the hardening of steel. To him, as Professor Sauveur remarks in his Biographical Notice of Osmond [TRANS. (1913) **45**, 274], we owe likewise the discovery of austenite, the non-magnetic solid solution of iron and carbon existing above the thermal critical range, and the transition-constituents, martensite, troostite and sorbite, marking as many distinct and important steps in the transformation, on cooling, of the solid solution austenite into the ferrite-cementite aggregate.

"This brings us to the date of Howe's first book on the subject; and the history of the new science, as I have already sketched it in general terms, is epitomized in the essays and books of Professor Howe from the appearance of his "Metallurgy of Steel" in 1888 to that of his "Metallography of Steel and Cast Iron" in 1916. The first of these books was an amazing accumulation of reported facts, tabulated, verified and explained as far as was then practicable. The last is an equally amazing array of facts, but now sifted, tested, logically arranged and luminously interpreted, exhibiting not uncomprehended differences, but significant similarities and relationships. The first was a heap, parts of which had been sorted; the last is an edifice. To produce the first required intelligent and

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inexhaustible industry and critical discernment. The second exhibits the creative genius of an architect. Between the two lies the history of a science to every state of which this builder has made some important contribution. Let me mention a few of these, under the heads of invention of improved methods; discovery of new facts; testing of data; and correlation and interpretation of observed phenomena. I shall not pretend to comprehensive completeness in this survey. I must be content with the exhibition of typical samples.

"One of the new methods invented by Professor Howe is that of determining the microstructural and other conditions which exist in steel at high temperatures by fixing those conditions through the process of quenching—a method which has been generally adopted, and by the use of which much clearer and more trustworthy results have been obtained than were formerly possible.

"Among his discoveries of new facts may be mentioned the isotropy of the effects of plastic deformation (announced in 1888, and supported in 1914); the possibility of effacing blowholes in soft steel by welding (1909); the relations of graphite flakes in cast iron, representing, not complete discontinuities of the metal, but only the filling by graphite of the interstices in ferrite skeletons; and the crystallography of the slip-planes ("Metallography of Steel and Cast-iron," 327). . .

"In a remarkable paper on the structure of steel, contributed to the proceedings of the American Society for Testing Materials for 1911, Professor Howe collected into the form of propositions or laws the observed relations of heat treatment to the microstructure and mechanical properties of steel. In that paper, he enunciated twenty-three of these laws; and had he then ceased from his labors, his work would have followed him as an imperishable record indelibly carved upon the history of science. But he was destined to go still further during the five years which followed. His latest book, "The Metallography of Steel and Cast-iron," published in 1916, occupies intellectually a higher plane than its predecessors, by which I mean that it commands a wider outlook, permitting grander generalizations, and the recognition, in due perspective, of causes, effects and relations. This book, in short, exhibits that simplification which I have described as following the stage of maximum complexity in the development of a science. Its very title, coupling steel with cast iron, expresses the maturer view which includes both in one continuous series, subject to the same laws—a significant conclusion of the controversy which began with the contention that steel was not cast iron. Not that the difference has been disproved, but that a higher unity has been shown to embrace it.

"That my estimate of the work of our great American colleague, as summed up and set forth in this book, is not merely an expression of personal affection or patriotic pride, let me prove by one or two opinions from eminent authorities.

"I would quote first a few paragraphs translated from a review of the book by Professor Le Chatelier in the *Revue de Mètallurgie* (March-April, 1916.):

> The new work of Mr. Howe is entirely original. It has nothing common with the numerous treatises on metallography which have appeared during the last ten years. Whoever has read one of them has read them all. Here we have to do with the personal observations and views of the author. As he indicates in his preface, he has written this treatise, not to state the solidly established principles of a young science, but to cause the creators of that science themselves to think; to open before them new horizons. Hence he has not feared to announce theories sometimes a little hazardous. . .
>
> This study will make an epoch in the history of the progress of science. It represents many years of uninterrupted research, but for a much longer period it will certainly be consulted by investigators with fruitful results.

"The following remarks are taken from a similar review by H. C. H. Carpenter, Professor of Metallurgy at the Royal Schoolof Mines, South Kensington, England.

> It is quite safe to say that Professor Howe's book will at once take its place as an authoritative, and indeed, classical, exposition of the field of knowledge with which it deals. From whatever standpoint it is judged, it is a great book—great in its power, lucidity, balance, comprehensiveness, and pre-eminently scientific character.

"In a private letter, written with reference to the announcement that the John Fritz medal was to be conferred upon Professor Howe, the same distinguished author says that he believes no award could have given greater pleasure to the metallurgists of Great Britain, who look upon Professor Howe not merely as the *doyen* of metallographists in America but as their most distinguished representative, a worker whose single-mindedness in the pursuit of truth is an example to us all, and whose conscientiousness gives to his publications a character of their own."

Doctor Howe is survived by his wife, to whom he was married on April 9, 1874. She was Miss Fannie Gay, of Troy, N. Y., and to her wise guidance and actual assistance and companionship in his work, Doctor Howe always justly attributed a large measure of his success. BRADLEY STOUGHTON.

## Frank Hudson Clement

FRANK HUDSON CLEMENT died on Feb. 18, 1922. He was born in Philadelphia on June 6, 1853, of Quaker stock, and was educated in the schools of that city.

From 1869 to 1874, Mr. Clement was an employee of Naylor & Co. of Philadelphia, manufacturers of iron and steel. In 1874, he studied the practical end of civil engineering and surveying with Hudson Shedaker, and in October of the same year entered the employ of the Pennsylvania Railroad, where he remained until January, 1878.

During the years 1876 and 1877, under Assistant Engineer W. L. Ziegler, Stacy Opdyke and others, Mr.

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Clement was engaged on the construction of the stock yards at Philadelphia and the West Philadelphia Depot, and the construction of the Pittsburgh Depot.

Early in 1878, Mr. Clement joined the ill-fated expedition of the Madeira and Mamora Railway Co. in Brazil. This expedition was the result of a contract by Philip and Thomas Collins for the construction of a line of railroad around the falls and rapids of the Madeira and Mamora Rivers, and was composed of men who later became prominent in various walks of life. The expedition failed because of lack of sanitation and inability to transport supplies.

Early in 1879, Mr. Clement entered the service of the Northern Pacific Railway Co. as assistant engineer and engineer to the vice-president, and in 1880 was topographical engineer on surveys for the Missouri and Yellowstone Divisions, under Col. J. T. Dodge. In 1881, he was engineer in charge of surveys and locations on the Mexican National Railway, and division engineer on completion of the Toluca Division.

In 1882, he returned to the United States as division engineer of the South Penn Railroad and spent four years in surveys, location and construction work. Later, he entered the construction business on his own account and built a portion of the New York Aqueduct. When this work was completed, he went to Cuba to take entire charge of the mines of the Cerebro company. When he returned to the United States, he contracted to build 35 miles of railroad in Maryland.

In 1890, in partnership with John C. Rogers of New York, he built the first Niagara Falls tunnel for the Niagara Falls Power Co.

Mr. Clement formed a partnership with Charles F. King under the firm name of Clement, King & Co. and after Mr. King's death, continued under the name of F. H. Clement & Co. Until 1906, Mr. Clement and his associates undertook and completed work costing many millions of dollars. They specialized in heavy railroad construction, so that today the Mt. Airy and Sand Patch tunnels on the Baltimore and Ohio Railroad, and the Galitzin and Baltimore tunnels on the Pennsylvania Railroad, the New York Central (Beech Creek) into Clearfield, Pa., and the Petersburg cutoff of the Pennsylvania Railroad are monuments to his ability.

From 1910 until the year previous to his death, Mr. Clement engaged in industrial work, principally for the Bethlehem Steel Corporation at Bethlehem, Pa., Steelton, Pa. and Sparrows Point, Md.; during the war he built for the same firm a shell-loading plant at Mays Landing, N. J.

Mr. Clement's long and prominent career was the result of elementary training, the overcoming of seemingly insurmountable difficulties, which in after years made the detail of his organization and work a simple matter. A characteristic of his life was his ability to make and retain friends. For 31 consecutive years, at his Port-Au-Peck clambake, were gathered, as his guests, the highest exponents of many professions and activities.

In 1885 Mr. Clement married Anna Louise Dietz, who survives him.

Mr. Clement was elected a member of the American Society of Civil Engineers on Nov. 1, 1862, and joined the American Institute of Mining Engineers in 1892. He belonged also to the Franklin Institute, the Verein Deutscher Eisenhüttenleute, and many civil and military organizations and clubs.

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## William H. Richmond

WILLIAM HENRY RICHMOND died on March 14, 1922, in the 101st year of his age. He was the eldest son of William Wadsworth and Clarissa (Bailey) Richmond, and was born in Marlborough, Hartford County, Conn., on Oct. 23, 1821. He was educated in the public schools of his native place, and at a select school in Middle Haddam, Conn., taught by Israel M. Buckingham, brother of Governor Buckingham of Connecticut.

In his 13th year, he entered business life as a clerk in a store at Middle Haddam, Conn. The panic in 1837 crippled his employer's business so that there was no work for the lad, and he returned to his home, where he found a similar condition of affairs. He remained on the home farm for five years, attending school, working on the farm and in the shop. In 1842, failing to secure employment in Hartford, he visited an uncle in Dutchess county, New York; there he met Robert H. Moore, of Socrates, N. Y., a merchant, and went with him to Honesdale, Pa. He remained in Mr. Moore's employ for three years, and then established a general store in Carbondale, Pa., in partnership with a Mr. Robinson, under the firm name of Richmond & Robinson.

In 1853, Mr. Richmond became sole proprietor of the business. Two years before, the firm had established a factory for making doors, sash, blinds, coal cars and other wood work, and had installed woodworking machinery. In 1859 and 1860, eight hundred coal cars were built at his factory, with the exception of axles and wheels, for the Delaware & Hudson Co. for use on the gravity railroad leading to Honesdale.

In January, 1860, Mr. Richmond commenced mining coal in Blakeley township, near Scranton, Pa. under the firm name of Richmond & Co., his partner being Charles P. Wurtz, general superintendent of the Delaware & Hudson Canal Co. They erected one of the first coal breakers on the line of that road, and commenced the breaking, screening and assorting of the coal for market, the previous practice having been to ship it in lump from the mine. In 1863, the firm was merged into the Elk Hill Coal Co., by special charter, with Mr. Wurtz as president and Mr. Richmond as treasurer and manager. The latter was actively an anthracite coal operator with mines near Scranton and

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north of Carbondale until about 1904, when he sold his interests and retired from business activities.

Mr. Richmond was a member of the American Institute of Mining and Metallurgical Engineers; National Geographic Society; Franklin Institute; Scranton Board of Trade; the New England Society of Northeastern Pennsylvania; Connecticut Society of Sons of American Revolution; the Society of Mayflower Descendants; American Association for the Advancement of Science; American Bible Society; and served as treasurer of the Lackawanna Bible Society for the last thirty years.

While in political views, Mr. Richmond agreed with many of the principles of the Republican party, he gave his loyal support to the Prohibition party, whose candidate for Congress in the twelfth district he was in 1868 and in 1904. For many years he was actively identified with the Presbyterian church, and his name appears frequently on the contribution lists of many religious organizations.

A man of many parts, keen and farsighted in business dealings, of deep and true religious conviction, a liberal supporter of the arts and sciences, and a citizen of strength and character, Mr. Richmond was one of the most distinguished members of Scranton society, the epitomization of unimpeachable integrity.

## James A. Lannon

JAMES ALFRED LANNON was born in Evanston, Wyo., Nov. 7, 1886. He graduated from the Colorado School of Mines with high honors in 1911 and was a member of Tau Beta Pi.

After graduation, Mr. Lannon followed mining and milling in Colorado, California and Mexico. He was foreman for a large company on the west coast of Mexico in the interior from Mazatlan, and later was agent for the Denver Engineering Co. for the sale of its products in Mexico City. He afterwards acted four years as superintendent of the Atlas Mining and Milling Co. at Sneffels, Colorado.

For the eighteen months preceding his death, Jan. 21, 1922, he was with the Lucky Twenty Mining Co. at Ouray as superintendent and stockholder, and had under construction an 1800-ft. tunnel on the property of the company.

Mr. Lannon was a man of excellent habits, and his classmates remember him as a man of exceptionally high honor and probity of character. He will be greatly missed by all who knew him. He was a member of the American Legion, B.P.O.E. Lodge No. 492 of Ouray, and also a member of the American Institute of Mining and Metallurgical Engineers.

Mr. Lannon married Miss Brita Bent, daughter of E. J. Bent of Ouray, five years ago, who, with a daughter four years of age, survives him. He leaves also his father and mother and six brothers and four sisters. His father is now a member of the Public Utilities Commission of Colorado, and his brother Frank, a graduate of the Colorado School of Mines, is and has been for a number of years, the general superintendent of the three U. S. zinc plants at Sand Springs, Henryetta and Cusa, Oklahoma.

## Edward S. Hutchinson

EDWARD S. HUTCHINSON died at his home in Newtown, Pa., on Feb. 17, after a short illness. For 25 years, he had walked with crutches, having lost one leg in an accident, but he was active and interested in civic affairs, despite his 81 years.

Mr. Hutchinson was born in Newtown, where his father was a practicing physician. After preliminary training in the schools of that town, he graduated from the Millersville State Normal School in 1859, and later attended the Polytechnic Institute at Philadelphia.

For about 20 years, he was construction engineer with the Pennsylvania Railroad Co. in the Middle Division, from Harrisburg to Altoona. After leaving this position, he was in the banking business at Altoona for a short time, and then spent about 15 years in the coal business in West Virginia.

After the death of his brother, 20 years ago, he returned to his home town and entered the real estate business from which he retired only a few months ago.

He was a Civil War veteran, having been a lieutenant in the U. S. Navy, and belonged to the G. A. R. Post of Newtown. He had been a member of the American Institute of Mining and Metallurgical Engineers since 1880, and also belonged to the National Association of Civil Engineers, the National Geographic Society, and the Engineers Club of Philadelphia.

Mr. Hutchinson is survived by his wife and three children, Mrs. John J. Lincoln of Elkhorn, West Va., Mrs. Martin J. Caples and E. Stanley Hutchinson, of Norfolk, Va.

## William N. Best

WILLIAM NEWTON BEST died on April 11, at his home in Brooklyn, N. Y. He was 61 years old, and had devoted the greater part of his life to the invention of devices for burning oil for heat. He held 44 patents for inventions of appliances used in the oil-burning industry.

Born in Quincy, Ill., he learned the trade of machinist in the railroad shops at Creston, Iowa, in 1877. He became superintendent of these shops, and later was with several other railroad companies. He began the study of liquid fuel while he was master mechanic and superintendent of the Los Angeles Electric Railway in 1887. His first burners were made of gas pipe, which produced a round flame, but these were soon flattened to produce a flat flame. This equipment was crude, but he continued his experiments and, in 1901, began the manufacture of his own inventions. He wrote several books on the science of burning oil, of which the

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most recent one, "Burning Liquid Fuel," was published only a short time before his death.

Mr. Best was a member of the A. I. M. E., of the American Railway Mechanics Association, of the Brooklyn Federation of churches, and was an officer in several local organizations of Brooklyn. He was a fellow of the Royal Society of Arts, of London.

## Robert Sticht

THE many friends of Robert Sticht will be grieved to learn of his death on April 30, 1922, at Launceton, Tasmania. Mr. Sticht was well known as the most successful exponent of pyritic smelting, which he developed to a high degree of perfection at the plant of the Mount Lyell Mining and Railway Co. in Tasmania.

Previous to his experience in that country, he had won a high place as a lead metallurgist in this country during the most active period of the smelting business in Colorado and Montana in the 80's and 90's. An account of his interesting career will be given in a later number of MINING AND METALLURGY.

## Alexander V. Adiassevich

ALEXANDER V. ADIASSEVICH died suddenly in Constantinople on Feb. 18, 1922. His death was caused by the rupture of a blood vessel, and was attributed by his friends to the nervous overstrain of his work against bolshevism, as he was only 56 years old and was apparently full of energy.

Mr. Adiassevich lived in Petrograd, Russia, in 1914, when he joined the Institute, and later on, when he left his home, he lost all of his fortune, in common with so many of his countrymen. His wife survives him.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Apr. 19, to May 15, 1922.

| DATE OF ELECTION | NAME | DATE OF DEATH |
|---|---|---|
| 1884 | BRANNER, JOHN C. | March 1, 1922 |
| 1921 | BUTZ, LOUIS N. | April 29, 1922 |
| 1921 | HICKS, EUGENE HENDEE. | April 10, 1922 |
| 1871 | HOWE, HENRY M. | May 14, 1922 |
| 1880 | HUTCHINSON, E. S. | Feb. 17, 1922 |

## Personal Notes

**E. Horton Jones** is general manager of the Heyward Minerals Co., Nicholasville, Ky.

**Charles L. Platt** is with the Anaconda Copper Mining Co. at Great Falls, Mont.

**Robert S. Davis** is in Guanajuato, Mexico, as mining engineer for the Guanajuato Consolidated Mining & Milling Co.

**James B. McNair,** chemist with the Bureau of Internal Revenue, has been transferred from Washington, D. C., to Chicago, Ill.

**K. F. Altio** assumed his duties as Consul General of Finland in New York, at the beginning of April, 1922. His office is at the Consulate, 5 State St., New York City.

**Walter C. Page** resigned his position as sales engineer for the Hardinge Co. in Salt Lake City to accept that of concentration engineer with the International Smelting Co. at Tooele, Utah.

**James Caldwell** has retired from the management of the Bote Mining Co. of Zacatecas, Mexico. He is vice-president of the Piedras Negras Mining Development Co. of the same place.

**B. J. Roberts** has resigned his position as manager of the Deister Concentrator Co. at Fort Wayne, Ind., to enter the service of the Southern Coal, Coke & Mining Co. of St. Louis, Mo.

**Thomas F. Donnelly** has returned from Antofagasta, Chile, where he has been president of the Cia. Huanchaca de Bolivia, and is practicing as a consulting engineer at 135 Broadway, New York.

**Charles L. Harrington** has purchased the engineering office of W. A. Funk, in Idaho Springs, Colo., and will continue the practice of mine examination and general engineering as related to mining.

**Henry A. Ley** resigned his position, effective May 15, as geologist with the Sun Co. at Dallas, Texas to become geologist in charge for the Southwestern Gas Co. of Independence, Kansas.

**Raymond F. Bacon,** recently director of the Mellon Institute of Industrial Research at Pittsburgh, has opened an office at 50 East 41st St., New York City, for work as a consulting chemical engineer.

**Albert L. Toenges,** resident engineer at Pittsburgh, Kansas, for the Western Coal & Mining Co., has been transferred to Jenny Lind, Arkansas, as superintendent of the Arkansas District for the same company.

**William Hutton Blauvelt** has resigned his position with the Semet-Solvay Co., of Syracuse, N. Y. and has opened an office as consulting engineer, in the Equitable Building, 120 Broadway, New York City.

**L. M. Kniffin** has returned to Fierro, New Mexico, as manager of the Hanover Bessemer Iron and Copper Co., a subsidiary of the United States Smelting, Refining and Mining Co. Operations were discontinued a year ago and have just been resumed.

**Louis S. Cates** has been made general manager of the Utah Copper Co. Mr. Cates will continue to be a director and assistant secretary of the company, and **R. C. Gemmell,** formerly general manager, will be assistant managing director of the Jackling properties.

**L. D. Huntoon** and **G. D. Van Arsdale** have dissolved partnership. Mr. Huntoon will continue practice as a consulting mining engineer at 115 Boradway, New York City, and Mr. Van Arsdale will continue as consulting chemist and metallurgist at 1011 South Figueroa St., Los Angeles, Cal.

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# Institute Affairs

## The San Francisco Meeting

MANY members will be gratified to know that the San Francisco Section of the A. I. M. E. has invited the Institute to hold its regular fall meeting in that city. It is eight years since a regular meeting of the Institute was held in San Francisco, and the memory of the last meeting is still vividly impressed on the minds of those who were fortunate enough to attend.

The gold-mining industry of California has felt the general depression which has been common to states where the baser metals are mined, but the spirit of our far Western members has not been correspondingly depressed, as is evidenced by their cordial invitation to the Institute. The gold mines of California are gradually coming back into their own, and their rise in prosperity will be all the more certain and permanent because there has been no artificial stimulant given to tide them over their period of depression.

The non-metallic industry on the Pacific Coast has become, during the last few years, a more prominent factor in our national economy. Its development was rapid during the war, but its growth has not been of the mushroom type. It has a real basis for existence.

Engineers from east of the Sierra Nevadas have much to learn from those who work on their western slopes, and it is hoped that many will be able to take advantage of the opportunity offered them this fall to learn more intimately of what our *confrères* have been doing on the Pacific Coast during the past eight years.

F. F. SHARPLESS.

## Nominating Committee for 1923

THE Board of Directors at its meeting on April 28 confirmed the president's appointment of the following Nominating Committee to prepare a ballot for the 1923 election. The By-laws of the Constitution provide "this committee shall consist of the chairmen of three local sections, one ex-president, and three other members of the Institute."

Robert Linton, chairman, 120 Broadway, New York City
Fred Crabtree, Carnegie Inst. of Tech., Pittsburgh, Pa.
James F. Kemp, Columbia University, New. York.
Walter E. McCourt, Washington Univ., St. Louis, Mo.
Arthur Notman, Phelps Dodge Corpn., Bisbee, Ariz.
D. M. Riordan, 650 Lake St., San Francisco, Cal.
Rush J. White, Shoshone Building, Wallace, Idaho.

The Constitution further provides that the official ticket prepared by this committee shall be transmitted to the Secretary of the Institute, not later than the last Friday in October, to be submitted to the Board at its October meeting for its consideration, published in the November magazine, and not later than Jan. 1 be printed and sent to the membership.

## June Meeting of Institute of Metals Division

THE Institute of Metals Division will meet with the American Foundrymen's Association June 5-9, at Rochester, N. Y. An account of the meeting will appear in the July magazine.

## Papers for the Fall Meeting

PAPERS to be presented at the fall meeting of the Institute must be in the hands of the Secretary not later than July 1, in order to secure proper consideration and publication prior to the meeting. This is of more importance this year than usual, because of the distance from the home office at which the meeting will be held.

At the last meeting of the Papers and Publications Committee, on May 19, it was unanimously voted to make this July 1 date a positive, final date, and to announce in MINING AND METALLURGY that papers received after that date shall not be presented at the fall meeting, but shall be held for the February meeting in 1923.

## Medals and Prizes for work on Iron and Steel and Platinum

THROUGH the generosity of the donors mentioned, the Institute is able to offer the following awards for work along the lines described below.

### THE HUNT MEDAL AND PRIZE

In 1920, the partners and employees of Robert W. Hunt & Co. established a fund for an annual medal and sum of money to be awarded for the best papers contributed to the Institute on iron and steel.

In general, papers dealing with the practical side of the subject will have preference over those dealing with the theoretical, in recognition of the fact that

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the industry is indebted to Captain Hunt for many improvements in production, both as to quantity and quality.

The money prize will not be awarded to a member over 40 years of age. Both prizes may be awarded to the same person if circumstances warrant and if he is within the age limit.

The first award will be made not earlier than 1923. Papers submitted for the award must reach the Secretary of the Institute not later than Aug. 1, 1923.

### The Hadfield Prize

Sir Robert Hadfield has offered a prize of $1000 to be awarded by the Institute for the best paper offered for publication on one of the following subjects:

(*a*) The determination of hardness in metals, in connection with super-hardness.

(*b*) Consideration of questions of fuel economy.

(*c*) Consideration of questions of industrial development and labor.

Papers submitted for award of the Hadfield prize should be in the Secretary's hands not later than Jan. 1, 1923.

### Lewisohn Platinum Prize

Walter Lewisohn, of New York, has placed at the disposal of the Directors of the Institute the sum of one thousand dollars to be awarded to the authors of papers of merit bearing on commercial uses of platinum.

The directors have adopted the following rules for the award of these prizes:

1. The first prize will be $500; the second, $325; the third $175.
2. The object of the papers will be to make public new commercial uses of platinum.
3. Its well known commercial uses and uses in jewelry will not be considered.
4. The material submitted may or may not be original with the author, but if not original due credit must be given for the source of the information.
5. No limit will be placed on the length of the paper, but the committee may require that it be condensed if that seems advisable.
6. The Institute reserves the right to publish the paper verbatim or in part or not at all.
7. The papers must be submitted to the Secretary of the Institute not later than Dec. 1, 1922, under a *nom de plume* accompanied by a sealed envelope containing the writer's name and address.
8. The writer need not be a member of the Institute.
9. No prize will be awarded if, in the opinion of the committee, no paper is submitted which merits a prize.

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## Transactions Wanted

MEMBERS who are willing to sell back volumes of the Transactions will confer a favor on the Institute if they will read the notice on page 18 of the advertising section.

## Summary of Minutes of April Meeting of Directors

AT THE meeting of the directors on April 28, 1922, there were present 12 directors, 13 invited guests, the secretary and assistant secretary of the Institute. The report of the Treasurer and Finance Committee was presented and approved.

The action of the Executive Committee in increasing the size of edition of Volume 66 from 8000 to 8325 copies was approved.

Thirty-two Members, 14 Associates, and 32 Junior Associates were elected to membership in the Institute. The status of one member was changed from Associate to Member, three from Junior Associate to Member, three from Junior Associate to Associate. Four were reinstated to membership in the Institute. Sixteen resignations were accepted. Upon request from three previously elected, they were granted an extension of time to accept election. The name of F. A. Emmerton was added to the Honor Roll of Senior Members.

The following Committee on Nominations was elected (see page 47.)

H. L. Hollis was elected representative of the Institute on the Washington Medal Board of Award, for a term of two years.

Arthur L. Walker was re-elected representative on National Research Council for three years.

The report of the committee appointed to formulate rules for the Lewisohn Platinum Prize was approved.

Oliver C. Ralston, a guest at the meeting from the Pacific Coast, was invited to present the views of the San Francisco and other Western members with whom he had come in contact respecting the various policies of the Institute, particularly as they relate to its publications. In reply to Mr. Ralston's statements, President Dwight, Messrs. Reynders, Jennings, Smith, Clevenger, Aldridge and Barbour made statements of the problems confronting the Institute, and the methods that had been adopted to try to meet them. The discussion was entirely amicable and resulted in a clearer understanding on the part of the directors of the Western attitude, and a better comprehension on the part of the Western representative as to the difficulties involved in the publication problems of the Institute.

There was presented from the representatives of A. I. M. E. on American Engineering Standards Committee a letter relating to the coöperation of the Department of Commerce with the A. E. S. C., and this was approved.

The report of the Joint Committee on a Code of Ethics for Engineers was again discussed, and it was voted that this be laid on the table.

The chairman of the Committee on Ground Movement and Subsidence presented a report for the previous year, and this was approved.

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# Local Sections and Affiliations

## Utah Section Officers

THE Utah Section recently elected the following officers: Henry M. Adkinson, chairman; D. D. Moffat, vice-chairman; E. R. Pembroke, secretary.

## Ohio Section Officers

OFFICERS of the Ohio Section, recently elected, are Zay Jeffries, chairman; C. H. Munger and F. R. Van Horn, vice-chairmen; C. B. Murray, secretary-treasurer; L. E. Wemple, E. T. McCleary and H. E. Wetherbee, members of executive committee.

## Colorado Section Changes Chairmen

THE executive committee of the Colorado Section met May 4, with all members present except Mr. Hursh. The secretary read a letter from Mr. Hursh offering his resignation as chairman on account of his leaving Colorado. J. C. Roberts was elected chairman of the section, and C. N. Bell, vice-chairman; Herbert Addison was elected to fill the vacancy on the executive committee.

## Action by San Francisco Section

AT THE meeting of the San Francisco Section, on April 11, "by motion duly made and seconded, the chairman was authorized to appoint a committee of three to draft a referendum to be submitted to all members of the Institute regarding the publication of MINING AND METALLURGY. The chairman appointed Frank L. Sizer, Corey Brayton and O. C. Ralston on this committee."

## New York Members Visit India and South America

THE regular monthly meeting of the New York Section was held on May 3, 1922. The chairman, Robert Linton presided. There were 124 members and guests present for the dinner and 160 for the program.

E. P. Mathewson, former chairman of the section, who recently returned from a professional trip to Burma, gave a very interesting talk with lantern slides of the outward journey by way of London and the Suez Canal. He showed some interesting views of the mine and smelter of the Burma Corporation, Ltd., and also some beautiful slides of views in Japan, the route by which he returned.

C. W. Van Law gave a most interesting talk on Peru and showed some beautiful slides of views in that country.

## Washington Section Meeting

THE Washington, D. C., Section of the Institute held a meeting on March 10, at which the following officers were elected for the ensuing year: chairman, Sidney Paige; first vice-chairman, S. S. Arentz; second vice-chairman, H. C. Morris; secretary-treasurer, John Alden Grimes; other members of the executive committee, E. A. Holbrook, G. K. Burgess, C. C. Griggs, S. B. Marshall.

M. J. Gavin, of the U. S. Bureau of Mines, read a paper on the Oil-shale Industry, which was an able presentation of the present status of the industry and the possibilities of future development.

## Southern California Section

THE Southern California Section held its monthly dinner and meeting on Feb. 10, 1922, at the Canterbury Inn, 42 members being present at the dinner.

The subject scheduled for the evening was the metallurgy of silver ores, but on account of the illness of Colonel Mudd, who was to lead the discussion, the meeting was devoted to informal talks by different members on various milling problems and an exchange of personal experiences.

The section held another meeting on April 21, with 40 members present. Rush T. Sill was acting chairman.

Mr. Hill, of the Aberhill Clay & Coal Co., gave an interesting talk on the commercial phase of the clay industry, which was followed by an informal discussion of various non-metallic deposits of the Southwest.

## Columbia Section Opposes the Denison Bill

THE Columbia Section held its regular monthly meeting on April 7, with 20 members present. Rush J. White, the chairman, presided.

The Committee on H. R. 10598, entitled the Denison bill, which was introduced in the House of Representatives as the "Blue Sky Bill," made a report which was unanimously endorsed by the members present, disapproving the bill.

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## Institute Section Joins Affiliated Technical Societies of Boston

THE 75th meeting of the Boston Section was held on April 3, 1922, with 21 members and guests present. The meeting was called to order by Chairman W. Spencer Hutchinson. The by-laws of the section were amended.

Prof. C. E. Locke gave an interesting talk on How Far Flotation is Indispensable Today, using as examples the Clausthal and Bonne Terre mills and Anaconda practice, past and present. He showed that much of the improvement in mill recovery that has been credited to flotation could have been accomplished by the improved methods of gravity concentration which have been developed in the past few years. He demonstrated this by a series of charts showing laboratory recovery obtained at Massachusetts Institute of Technology over a long term of years, using the same ore from a mine in Virginia.

The conclusion arrived at was that while flotation has done good work in many places in obtaining recoveries that could not have been attained by other methods, its greatest advantage and the one which has lead to its being so generally adopted is that it is to a certain extent "fool proof."

The 76th meeting of the section was held on May 1, with 51 members and guests present. Chairman W. Spencer Hutchinson presided.

The secretary reported that at a meeting of the Executive Committee on April 18 formal action was taken accepting the invitation to join the Affiliated Technical Societies of Boston. Allen H. Rogers and S. Spencer Hutchinson were elected as representatives of the section on the council of the affiliation.

F. F. Sharpless, Secretary of the Institute, then gave a five-minute talk on the aims and functions of the Institute, and the purposes of its publications, especially MINING AND METALLURGY. A short discussion followed.

G. H. Clevenger, the speaker of the evening, spoke on liquid-oxygen explosives, starting with a historical sketch of their development and ending with a description of the experimental installation at the mines of Compañia de Real del Monte y Pachuca and a brief résumé of the results obtained to date.

Mr. Clevenger showed samples of the cartridges and cartridge material used and his talk was illustrated by about a dozen lantern slides showing equipment for handling and transportation of liquid oxygen.

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## Muscle Shoals Project

BIG stocks of munitions in times of peace were urged by Major General C. C. Williams, Chief of Ordnance, U. S. A., at a national forum on Muscle Shoals held under the auspices of the Ordnance Division of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers and other engineering and army organizations in the Engineering Societies Building, New York City, on April 14.

"Unless we are willing to allow the country to return to a condition of practically complete military incompetency," said General Williams, "we must all strive for the principle of adequate reserves of fighting materials. Nitrogen is only one of the elements that enter into munitions and military preparedness. We must keep on hand sufficient stocks of usable and reasonable up-to-date designs to supply our armies until production is adequate. Otherwise, our armies are bound to be short of munitions in the all-important first days of the war."

General Williams said that, assuming that the Muscle Shoals Nitrate Plant "is in standby at the start of war and in full production within 10 months thereafter, with imports stopped and one-third of byproduct coke oven capacity applied to munitions production, we would have to retain stocks of nitrogen in the form of nitrate of soda, powder and explosives or assembled ammunition to the extent of 74,000 short tons." General Williams assumed that production would equal consumption 22½ months after war had broken out.

W. S. Landis, chief technologist of the American Cyanamid Co., declared that the outlook for an immediate commercial operation of U. S. Nitrate Plant Number 2, the Muscle Shoals plant, is extremely discouraging. "It is a war plant built to furnish a special war requirement," he said. "That requirement disappeared with the signing of the Armistice, and we have not yet found a commercial peace-time outlet for the products of the kind and quantity that the plant may be adapted to make.

"We all hope a commercial use for this plant may be found, but we are not in sympathy and believe that engineers will stand with us in opposing any proposal that involves subsidized operation; disregard of all relationship between costs of production and selling prices, or destructive governmental competition with private industry. You can rest assured that private industry will continue to give the closest attention to developing every possibility that might lead to a future peace-time operation of the Muscle Shoals Nitrate Plant on a fair, unsubsidized commercial basis."

Brigadier General Harry Taylor, Assistant Chief of Engineers, U. S. A., spoke on Muscle Shoals as a Power Producer. Motion pictures of Muscle Shoals development were explained by Theodore Nagel, consulting engineer. A general discussion was led by E. A. Yates, engineer, and Francis E. Frothingham of Coffin & Burr, bankers.

General Williams pointed out that during the average month of the year 1918 the British and French armies consumed over five times as much fixed nitrogen as was consumed by all of the Union forces during the entire

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Civil War. During the year 1918, we were consuming inorganic nitrogen in the United States at the rate of 420,000 tons per year, and of this over 60 per cent. was for munitions. "Based on these experiences of the past," he added, "there seems to be little doubt that future requirements in a major war effort will be materially greater than the already gigantic demand."

Byproduct ovens are most important to the future of America, General Williams said. Estimating the remaining life of the vast deposits in the rainless deserts of northern Chile of "calliche," from which the commercial salt known as nitrate of soda or Chile saltpeter is refined, from 50 to 200 years, General Williams said:

"While the remaining life is unknown, we do know that these deposits cannot last forever if the present rate of production continues which is at the rate of some 2,500,000 tons per year. The future, therefore, must gradually abandon this source of supply."

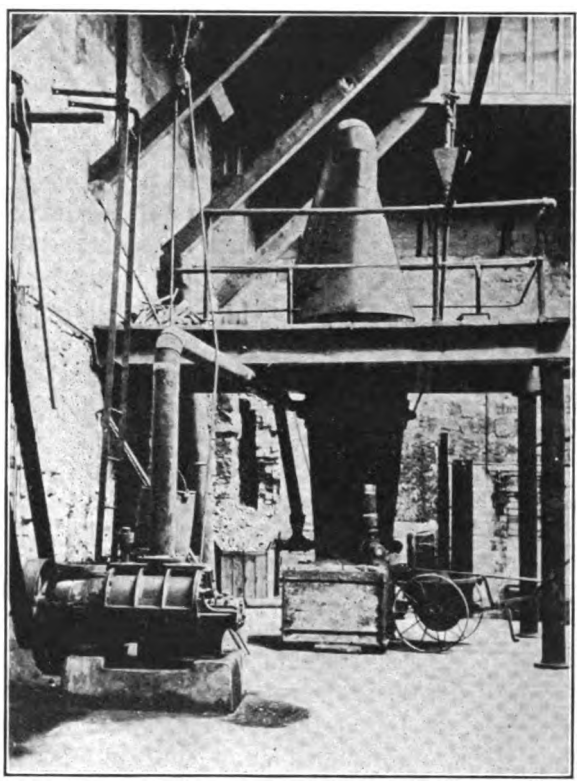
Discussing the commercial possibilities of the Muscle Shoals plant, Mr. Landis said that a multitude of suggestions cropping up are worthless. "Prior to the World War," he continued, "the American production of ammonia was equivalent to 183,000 tons of sulfate of ammonia and American consumption in that year was 272,000 tons; but in 1920 we produced approximately 515,000 tons, consumed in this country 320,000 tons, exported 130,000 tons, and carried over the remaining 55,000 tons as a surplus. From dependence on Great Britain and Germany to supply us with a part of our ammonia requirements, we have been transformed by the enormous expansion of the byproduct coke-oven industry during the war into one of the greatest ammonia-exporting nations of the world. Meanwhile the price has come down to a point representing about two-thirds the cost of manufacturing this material at Muscle Shoals."

Mr. Frothingham classified Ford's proposal to turn the Muscle Shoals water power project into a commercial undertaking as "a visionary picture that challenges the sense of reality of the commonsense business man and citizen." He accused the automobile manufacturer of seeking a "perpetual monopoly" for which the Government must pay the bills. After charging Mr. Ford with attempting to set the Federal water power act at naught, Mr. Frothingham went on to outline the proposition made by the Alabama Power Co., which is a competitor with Mr. Ford, to secure the Muscle Shoals project as it now stands.

"This power company," said Mr. Frothingham, "agrees, if the Government accepts its proposition, to finish at its own expense the operations started, and to acquire its franchise under the terms of the Federal water power act. The power it will develop from the completed project will be furnished to industries of the South at reasonable rates and under strict regulation. This company's plan is sound from a business standpoint and differs vastly from that of Mr. Ford."

## Affiliated Student Societies

**University of Wisconsin.**—During the current semester, the Mining Club has conducted a series of discussional meetings to promote interest in civic affairs. These meetings have strengthened the organization and served as a source of valuable information to the members of the club. Mine taxation, the income tax, the inheritance tax, and land rent have all served as subjects of discussion. Mr. Harrington, of the Wisconsin Tax Commission, spoke on The Waste between Production and Consumption. State Finance has also been studied under the leadership of Mr. Borden, of the Wisconsin Board of Public Affairs.



PART OF ONE OF THE METALLURGICAL LABORATORIES, UNIVERSITY OF WISCONSIN, SHOWING THE BLAST FURNACE.

Governor Blaine was the speaker at the annual banquet. The "fresh miners" were introduced to real miners' food, featuring Cornish pasties.

At a joint meeting with the Mining Seminar, a study of the curricula of several mining schools was made and discussion followed on training for mining engineers.

The annual picnic at Lake Mendota will be the last meeting of the semester.

**South Dakota State School of Mines.**—At a meeting of the Drill and Crucible Club on April 27, Prof. Jay A. Carpenter spoke on mining as a profession, and Prof. Bancroft Gore told of the possibilities for a metallurgist in South Africa. On May 1, the club showed a film on the Manufacture of Armco Ingot Iron, through the courtesy of the American Rolling Mill Co.

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**University of Kansas.**—The Mining and Geology Club has thrown off most of the apathy carried over from the years of the war, and is undergoing an increase in interest that makes it again worthy of the rank of one of the most active as well as the oldest auxiliary society of the A. I. M. E. The society is composed of advanced students of the mining and metallurgical departments, and its purpose is to interest its members in the science of mining. Meetings are held twice a month, at which papers are presented by members of the society and the faculty, and by practical mining engineers and geologists when they can be secured. These meetings are open to and are usually attended by members of the other departments.

The second meeting of the year was a smoker for the combined mining and geological departments. At the meeting of March 7, Dr. David White, chief geologist of the U. S. Geological Survey, spoke on The Needs of Geology. On March 25, Col. Arthur S. Dwight, president of the Institute, gave an illustrated lecture on the Sintering and Roasting of Ores. Colonel Dwight also met the students of the department and told them of the value of membership in the Institute. His visit was a real inspiration to the students and the faculty. On April 1, Henry M. Payne, mining engineer of New York City, gave an illustrated talk on Mexico.

The society feels that it has been especially fortunate this year in having the opportunity of hearing men of such prominence in the science. In addition to the addresses the society has taken advantage of the moving picture service of the Bureau of Mines, and about a half dozen pictures have been shown.

The officers of the society are: Joseph H. Turner, president; Ernest L. Ackley, secretary-treasurer.

**University of Alabama.**—The last meeting of the Mining and Metallurgical Society was held on May 18. The club was exceedingly fortunate in having an address from one of the best known mining engineers in the state, C. H. Nesbit, Alabama State Mine Inspector. His talk included many points of importance to the undergraduate engineers, such as mining possibilities in Alabama, mining methods, mine rescue and mine disasters. Mr. Echols, assistant to Mr. Nesbit in the Tuscaloosa district, also gave a talk on mining coal in inclined seams.

Officers of the society for the coming year were then elected, as follows: R. B. Duggar, president; F. C. Nix, vice-president; J. J. Ashton, secretary-treasurer.

The club has been fortunate this last year in having two members of the faculty on the roll: H. D. Pallister, professor of mining, and E. C. Wright, professor of metallurgy. The growth of the club has been largely due to their efforts; it is now one of the liveliest organizations at the University.

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**Gasoline from Still Vapors.**—According to the U. S. Bureau of Mines, 128,000 gal. of gasoline are being recovered daily from vapors coming from stills or refineries that are using compression or absorption processes.

## Woman's Auxiliary

AT THE meeting of the Board of Directors of the W. A. A. I. M. E. on April 6, Mrs. Hardinge, the president, was in the chair; 10 directors were present and Mrs. Philip Wiseman, of Los Angeles, was a guest. The treasurer reported a balance on hand at the first of the month of $780.47.

Mrs. Westervelt reported that the new Constitution and By-Laws had been printed and would be sent to all members with the annual report of the Auxiliary as soon as the latter was ready.

Mrs. Wolff, representing the Denver Section, reported by letter the death of the former chairman of that section, Mrs. Thomas B. Stearns. The secretary was instructed to convey to Mr. Stearns the sympathy of the Auxiliary in his sorrow, and appreciation of the splendid work that Mrs. Stearns had done for the Auxiliary.

Mrs. Henderson, representing the Boston Section, reported that the women connected with the engineers of Boston had held a meeting at the Engineers' Club on March 24, at which 10 were present, and had formed a section, with Mrs. Robert H. Richards as chairman and Mrs. W. H. Coburn as secretary.

The New York Section reported that 46 members had attended its monthly luncheon at the "Armchair," once the home of F. Hopkinson Smith, at which an interesting address by Professor Covington, of Princeton, was given on The Public Speaker as an Artist. Mrs. Carney reported that this section had completed over 100 garments for the Community Chest at its weekly sewings held at the rooms of Mrs. Barron, at the Hotel Belmont.

To the New York Section, the Board of Directors assigned the duty of administering the libraries which the Auxiliary is preparing to send out to various mining camps.

Mrs. Jennings, chairman of the Educational Fund Committee reported that diligent search had been made for a suitable candidate for the Columbia Univeristy scholarship, and that a suitable man had been found in Carleton B. Janson, of Schenectady.

It was reported that Mrs. Aldrich, on her recent visit to California, had seen James Christie, the beneficiary of the Woman's Auxiliary scholarship at Berkeley, had investigated his record, and found that he was doing very creditable work.

At the regular monthly meeting on May 4, fourteen members were present. The treasurer reported a balance on hand, May 1, 1922, of $904.54. Reports from the sections were made as follows:

*Southern California Section.*—Mrs. Wiseman read a long and interesting letter from Mrs. F. B. Close, describing the visit of Mrs. Hoover. By suggestion of Mrs. H. V. Winchell, the section gave a tea for Mrs. Hoover, at the Ambassador Hotel, at which Mrs. Hoover made a brief and forceful address on

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what she considered the aims, or objects of the Auxiliary, stressing the fact that, first and foremost, we are organized to be friendly and helpful to the wives, sisters and mothers of mining engineers who come among us as strangers. She alluded to the Educational Fund, local charities, etc., adding that there are always fresh objects to work for. One in which she has recently become interested is a movement to start units of the Girl Scouts in mining camps where, at present, there is no common out-door activity for them. Mrs. Hoover has been made president of the National Organization for one year.

*Northern California Section.*—This section reported a luncheon on March 29, at which Mrs. Hutton presented the opportunity of the Auxiliary to help in providing a comfortable and attractive study room for the use of the students of mining at the University. It was ordered that a small monthly assessment be made, for the Study Room Fund. Mrs. Philip Bradley, Mrs. Labarthe and Mrs. Dischak were appointed a committee to raise additional money for this fund. A letter was read from Mrs. Raymond, chairman of the Chest Committee, asking the interest of all branches in making and providing clothing for destitute miners' children. Owing to the fact that this section is young and has started other activities, this letter was laid on the table. A letter from Mrs. Jennings was read in which she told of the needs of our scholarship beneficiary, James Christie, asking that this section help in whatever way possible.

*Denver Section.*—Mrs. Wolf presented the report of this section, which held a special meeting on April 20, at the home of the chairman, Mrs. Leonard. The section discussed ways and means of raising money for the Scholarship Fund, also Mrs. Raymond's letter regarding the Emergency Chest.

*Chicago Section.*—The chairman, Mrs. L. V. Rice, at the regular monthly luncheon on March 31, made an interesting report of her attendance at the annual meeting of the A. I. M. E. in New York, last February, from which she took back with her "enough enthusiasm to share with the other members of the Auxiliary."

*Butte Section.*—The serious epidemic of influenza in the late winter prevented meetings. At present the plans consist of a possible milk station and an entertainment for the members of the Anaconda Section. Mrs. Norris gave so glowing an account of the annual meeting of the A. I. M. E. that all the members of this section "felt happy to know that we were a part of such a great organization."

*Anaconda Section.*—There was no regular report, the chairman, Mrs. Adams and the secretary, Mrs. Frick, being ill. Mrs. Mathewson spent two days in Anaconda recently, breakfasting one morning with Mrs. Tanner. The section sent a bunch of beautiful roses to Mrs. Mathewson.

*New York Section.*—This section made up 400 yd. of material into 119 garments during the Lenten sewing meetings. On the last Wednesday in June the section will have one more afternoon of sewing at the house of Mrs. Dwight, at Great Neck.

The plans for the libraries in mining camps have been completed and a number of books will be sent out in the near future. A theatre party was held to raise money for the Library Fund.

The regular monthly luncheon of the section was held on April 26. Mrs. John A. Church was to have spoken on her experiences in Manchuria, but was prevented by sudden illness. Mrs. Jennings stepped into the breach, on urgent request, and related in a most delightful and amusing manner some of her experiences in South Africa during the Jameson raid, telling anecdotes of Cecil Rhodes and President Kruger. Mrs. Warriner, who recently returned from South Africa, told of an interesting occurrence during the late war.

### Reports of Committees

*Educational Fund.*—Mrs. Jennings, chairman, reported the withdrawal of Carlton B. Jansen from the candidacy for the Columbia University and W. A. A. scholarship.

*Chest Committee.*—Mrs. Raymond, chairman, reported the discontinuance of the weekly meetings for the making of garments for the Emergency Chest, which were held, through the courtesy of Mrs. George D. Barron at her rooms in the Belmont Hotel. Mrs. Raymond has sent a letter to the chairman of each section, explaining the object of the Emergency Chest.

### New Business

It was ordered that cards be printed to announce change of address and sent to the chairman of each section, these cards to be returned to the acting chairman of the Membership Committee, Mrs. Dwight.

A letter was read by Mrs. Dwight from Mrs. Herbert Hoover, suggesting that the W. A. A. I. M. E. join in the Girl Scout movement by establishing units in small towns throughout the West, especially in mining communities. After discussion, the following resolution was passed:

> The Board of Directors of the Woman's Auxiliary to the A. I. M. E. heartily endorses the work of the Girl Scouts, which at this time is so ably led, as president, by Mrs. Herbert Hoover, chairman of the Membership Committee of the Woman's Auxiliary. The Board of Directors hereby recommends this work to the membership and to the sections.

The next meeting will be held on Oct. 5, 1922, at 29 West 39th St., New York.

## Engineering in Northern Brazil

THE Engineers Club of Pernambuco, 447 Rua 15 de Novembro, Recife, an association of engineers and business men engaged in different industries, is making a record of laws and other information regarding engineering in northern Brazil, and will be glad to be of service to those who need its assistance.

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## Transactions of International Engineering Congress, 1915

THE Transactions of the International Engineering Congress which was held in San Francisco simultaneously with the Exposition celebrating the opening of the Panama Canal are now available through the Engineering Societies Library, 29 W. 39th St., New York City. These papers form a valuable contribution to any collection of modern engineering literature, since the congress, in scope and character, was truly international.

The set consists of eleven bound volumes accompanied by an index volume giving a historical and statistical account of the congress, abstracts of all the papers presented and a very usable table of contents and author index. With the exception of the volume on the Panama Canal, the treatment given each subject has been in the nature of a broad survey with some special reference to important lines of engineering advance. The papers are accompanied by a bibliography of the literature of each subject so that the reader can extend his research into any one of the topics treated.

Few complete sets are left, but the library has quite a large number of some of the individual volumes and papers which it will gladly supply to those who wish to purchase them. Volumes are $3 each, and papers are priced at a correspondingly low rate.

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## American Electrochemical Society

THE spring meeting of the American Electrochemical Society was held in Baltimore, Md., April 27–29. One of the outstanding features of the program was the conferring of honorary membership on Dr. Carl Hering, one of the founders of the society. He is a noted electrical engineer and has made extensive studies on electric furnaces.

C. G. Schluederberg, of the Westinghouse Elec. & Mfg. Co., was elected president of the society; F. A. Lidbury, of Niagara Falls, treasurer; and Colin G. Fink, 101 Park Ave., New York, secretary.

The fall meeting is scheduled for Sept. 21–23, 1922, at Montreal, Que., Canada.

# Increase of Membership Department

**Total membership as of May 6, 1922, is 10,094**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period April 19, to May 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

### Members

**1—William Henry Foster,** Dallas, Tex.
Present position: Consulting Work, Foster & Reiter, Consulting Geologists, Tulsa, Dallas & Mexia, Tex.
Proposers: F. Julius Fohs, Heath M. Robinson, W. A. Reiter.

**2—Paul P. Goudkoff,** New York, N. Y.
Present position—1920 to date: Chairman of the Delegation of Maritime Chamber of Commerce.
Proposers: James F. Kemp, Robert M. Raymond, J. Barton Nealey.

**3—William Scouller Jennings,** Katherine, Ariz.
Present position—1921 to date: Superintendent of the Illinois-Katherine Mining Co.
Proposers: George F. Williston, R. C. Jacobson, S. Ford Eaton.

**4—Johan Kempe,** Ludvika, Sweden.
Present position: Disponent (manager) for Grufalsticbelogst Dalame.
Proposers: Walfr. Petersson, Alf Grabe, B. G. Markman.

**5—William Abram Linfesty,** Oatman, Ariz.
Present position—1919 to date: Mill Superintendent, Tom Reed Gold Mines Co.
Proposers: W. B. Phelps, Earle M. Bagley, Roy W. Moore.

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**6—Kyuzo Munagi,** New York, N. Y.
Present position—1920 to date: Chief Engineer, Excavating Department of Open Pit, Fushun Colliery, Manchuria, China.
Proposers: Robert Peele, Jitaro Yonezawa, Gaichi Yamada.

**7—John Henry Nagle,** Du Bois, Pa.
Present position—1920 to date: Chief Engineer, Northwestern Mining and Exchange Co.
Proposers: Seth W. Bloom, E. W. Hess, O. P. Hess.

**8—Horace Bushnell Patton,** Eureka, Kans.
Present position: Consulting Geologist; Geologist, Ogallala Oil Co.
Proposers: F. F. Sharpless, James F. Kemp, H. C. Parmelee.

Associates

**9—John B. Corrin,** Wilkinsburg, Pa.
Present position—1902 to date: Land Agent, Assistant General Superintendent, Assistant Manager, Vice-president, Hope Natural Gas Co. and General Manager, Reserve Gas Co.
Proposers: J. K. Anderson, C. E. Krebs, Frank Haas.

**10—Aram Garabed Boghossian,** New York, N. Y.
Present position: Geologist and Engineer, Powell Div. Co., Chicago, Ill.
Proposers: William F. Jones, Frederic H. Lahee.

**11—Hewitt Onderdonk Fearn,** Oyster Bay, N. Y.
Present position: Unemployed.
Proposers: F. E. Wormser, Robert Peele, L. D. Huntoon.

**12—W. K. Kavanaugh,** St. Louis, Mo.
Present position: President, Southern Coal Coke & Mining Co.
Proposers: Eugene McAuliffe, Arthur Thacher, Philip N. Moore.

**13—Kenneth Burnham Lewis,** Worcester, Mass.
Present position—1909 to date: Manager of Sales, Department Wire Drawing Machinery, Morgan Construction Co.
Proposers: C. P. Perin, Donald Belcher, F. L. Estep.

**14—Howard James MacLachlan,** New York, N. Y.
Present position—1920 to date: Attorney with Texas Gulf Sulphur Co.
Proposers: W. H. Aldridge, R. H. Stewart, S. W. Mudd.

**15—Ernest Munoz,** Santiago, Chile, S. A.
Present position—1921 to date: In Santiago, making reports and mining studies.
Proposers: Lester W. Strauss, John R. H. H. Billyard, S. H. Loram.

**16—Frank Pardee, Jr.,** Hazleton, Pa.
Present position—1921 to date: Manager, Anthracite Separator Co.
Proposers: Frank G. Pardee, Frank Pardee, J. B. Warriner.

Junior Associates

**17—James Arthur Adams,** Corvallis, Ore.
Student, Oregon State College.
Proposers: J. H. Batcheller, Charles E. Newton, G. E. Stowell.

**18—Richards Johnson Bard,** Boston, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Charles E. Locke, Edward E. Bugbee, Carle R. Hayward.

**19—Louis J. Bittner,** Columbia, Pa.
Student, Pennsylvania State College.
Proposers: A. M. Rodgers, D. F. McFarland, William R. Chedsey.

**20—Jacque Lynne Brown,** Hamilton, O.
Ohio State University.
Proposers: D. J. Demorest, William J. McCaughey, H. E. Nold.

**21—Mark Granville Dance,** Lawrence, Kansas.
Student, University of Kansas.
Proposers: C. M. Young, Erasmus Haworth, R. S. Knappen.

**22—Theodore Decker,** Houghton, Mich.
Student, Michigan College of Mines.
Proposers: F. W. McNair, J. B. Cunningham, F. W. Sperr.

**23—Henry Clay Fisher,** Corvallis, Ore.
Student, Oregon State Agricultural College.
Proposers: Charles E. Newton, James H. Batcheller, G. E. Stowell.

**24—Charles Reber Fondersmith,** Pittsburgh, Pa.
Student, Carnegie Institute of Technology.
Proposers: Fred Crabtree, Edward Steidle, Charles R. Fettke.

**25—James Frank Frost,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, I. A. Palmer.

**26—Robert Franklin Grady, Jr.,** St. Louis, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, C. L. Dake, J. R. Guiteras.

**27—Kenneth Earle Hamblen,** Portland, Ore.
Student, Oregon School of Mines.
Proposers: J. H. Batcheller, Charles E. Newton, G. E. Stowell.

**28—Ingrald Timothy Harstad,** Parkland, Wash.
Student, University of Washington.
Proposers: Joseph Daniels, Milnor Roberts, Henry Landes.

**29—Albert J. Hoch,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Benjamin L. Miller, G. A. Roush, H. B. Pulsifer.

**30—Louis Hoffman,** Minneapolis, Minn.
Student, University of Minn.
Proposers: W. R. Appleby, E. H. Kersten, E. H. Comstock, Walter H. Parker.

**31—H. William Johnson,** Joliet, Ill.
Student, University of Illinois.
Proposers: W. S. Putnam, A. E. Drucker, H. H. Stoek.

**32—Jacob Levinson,** Pittsburgh, Pa.
Student, Pennsylvania State College.
Proposers: D. F. McFarland, A. M. Rodgers, C. A. Bonine.

**33—Sze Chen Lin,** Minneapolis, Minn.
Student, University of Minnesota.
Proposers: W. R. Appleby, Peter Christianson, W. H. Parker.

**34—Harvey Croxton Long,** Portland, Ore.
Student, Oregon School of Mines.
Proposers: J. H. Batcheller, Charles E. Newton, G. E. Stowell.

**35—John Brown Moore,** State College, Pa.
Student, Pennsylvania State College.
Proposers: William R. Chedsey, A. M. Rodgers, D. F. McFarland.

**36—Donald Stuart Phelps,** Farmington, Conn.
Student, Massachusetts Institute of Technology.
Proposers: Charles E. Locke, Carle R. Hayward, Edward E. Bugbee.

**37—Norton Henry Reichenbach,** Allentown, Pa.
Student, Pennsylvania State College.
Proposers: D. F. McFarland, William R. Chedsey, C. A. Bonine.

**38—Paul Kress Richardson,** Corvallis, Ore.
Student, Oregon State College.
Proposers: James H. Batcheller, Charles E. Newton, G. E. Stowell.

**39—Joe Wood Tibbetts,** Corvallis, Ore.
Student, Oregon State Agricultural College.
Proposers: J. H. Batcheller, Charles E. Newton, G. E. Stowell.

**40—Luis de Uribe-Echebarria,** Minneapolis, Minn.
Student, Minnesota School of Mines.
Proposers: Peter Christianson, W. R. Appleby, Walter H. Parker.

**41—Douglas Weatherston,** Berkeley, Cal.
Student, University of California.
Proposers: Frank H. Probert, W. S. Morley, Lester C. Uren.

**42—James Lloyd White,** Houghton, Mich.
Student, Michigan College of Mines.
Proposers: F. W. McNair, F. W. Sperry, J. B. Cunningham.

**43—Floyd Jackson Wilson,** Franklin, Mass.
Student, Massachusetts Institute of Technology.
Proposers: Charles E. Locke, Edward E. Bugbee, Carle R. Hayward.

**44—John Russell Zimmerman,** Berkeley, Cal.
Student, University of California.
Proposers: Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Change of Status— Associate to Member

**45—Melvin Miller Garrett,** Wichita Falls, Tex.
Present position: Geologist, Middle States Oil Corporation Subsidiaries, in Texas.
Proposers: Jon A. Udden, E. E. Schramm, A. C. Veatch.

Change of Status—Junior Associate to Member

**46—Henry Alfred Ley,** Independence, Kansas.
Present position: Chief Geologist, Southwestern Gas Co.
Proposers: W. E. Wrather, Wallace E. Pratt, Frederic H. Lahee.

**47—Sydney A. Mewhirter,** Metcalf, Ariz.
Present position: Mining Engineer, Coronado Division, Phelps Dodge Corpn., Morenci, Ariz.
Proposers: H. G. Scott, John Kiddie, H. A. Leidich.

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# Engineering Societies Library

HARRISON W. CRAVER, Director

The Engineering Societies Library, on the 13th floor of the Engineering Societies Building, 29 West 39th St., New York, contains approximately 150,000 volumes of engineering literature. It is open on week days, excepting holidays, from 9 a.m. to 10 p.m.

The Library offers, upon payment for the extra work required, to supply photoprints or translations of articles, make searches for information, prepare lists of references and suggest books on engineering subjects. The cost of searching is $2 an hour. Translations cost $6 and upwards per thousand words. Typewritten copies, $1 a thousand words. Photoprints, 11 by 14 in., cost $0.25.

In cases where the Library contains two copies of a book, one may be borrowed by any member. Transportation costs must be paid by the borrower.

The Library is at the service of every member. Those who cannot visit it may order searches, translations, copies, etc., by mail.

Address correspondence to the Director, Harrison W. Craver, 29 West 39th St., New York.

## Book Reviews

**Burning Liquid Fuel.** By William Newton Best. New York, U. P. C. Book Co., Inc., 1922. 341 pp., illus., diagrs., 6 × 9 in., cloth, $5.

This book contains data covering all the various forms of equipments used in the burning of liquid fuel, which were obtained from thousands of actual tests and are the results of experience covering more than 33 years in the burning of oil and tar by the dean of the liquid fuel profession, who has recently died.

Beginning with a short chapter on the origin, production, and analysis of liquid fuel, the book takes up the subject of atomization, oil systems, refractory materials, and then the different types of equipment for nearly every form of furnace including:

Annealing, asphaltum mixers, babbitt heating, bolt making, brass melting, brazing, bread ovens, etc., brick and art tile kilns, case hardening, cast iron melting, cement kiln rotary, channel iron heating, chocolate bean roasters, continuous heating, copper plate, core drying, crematories, crucible brass melting, crucible steel melting, drop forge work, enameling, flue welding, glass lehrs, glass melting, incinerators, indirect-fired japanning ovens, ladle heating, locomotive steam raising, locomotive tire heating, malleable iron, mold drying, ore smelting, plate heating, pipe bending, pipe flange welding, portable torches, rivet making, rolling mill work, rotary kilns, shaft and billet heating, sand drying, sheet steel heating, steel melting, steel mixers, tar stills, tempering, welding scrap iron, wire annealing, wire making.

"The burning of liquid fuel," says the author, "is a science. It can be burned either wastefully or economically."

The author maintains that "men wanting to run tests on boilers and furnaces, using all the different types of burners which they can borrow for the occasion," men who have never "had any theoretical or practical experience in the burning of oil or tar" arrive at results as absurd "as though two men neither of whom had ever previously shot off a gun were to institute a shooting contest, borrowing as many weapons as they could from the various gun manufacturers, assuring them that the result of the contest would be of great advantage to the firm that was fortunate enough to win in the contest."

In a foreword to the book, Rear Admiral John R. Edwards, retired, says: "Your distinct fitness to write upon this important subject will be recognized by our leading engineering experts, not only by reason of your broad experience as regards oil fuel matters but likewise due to the varied, progressive and successful results accomplished by you along that line.

The Navy as well as the Nation is therefore indebted to you for the far-reaching military and engineering counsel you rendered your country in promoting the successful development of the oil-burning furnace—an achievement of importance whether viewed from an industrial, maritime or strategic standpoint."

The book is replete with illustrations and drawings which enhance the value of the data in the text, and is a distinct addition to the literature on the subject. P. E. B.

**Chemical Engineering.** By Edward Hart. Second Edition. Easton, Pa., 1922, Chemical Publishing Co., 14 plus 241 pp., 229 illus., 6 × 9 in., cloth $4.

This is the second edition of this very interesting book, not the least interesting comment in which is found in the preface to the second edition, "Reviewers will please take notice that this is a textbook and not a manual. I expected great things of these reviewers but I have not found them; in some cases they were clearly incompetent and in some they had not even read the book; this I regard as essential in the preparation of any book review."

When the author dismisses the subject of iron in nine lines of text, he should not be offended if an impartial reviewer considers his book a manual rather than a textbook. This is true of other subjects in the book. However, the book is a useful one and has chapters dealing with materials, corrosion, location of work, industrial management, boilers, time movers, plumbing, pumps, crushing, mechanical handling of material, dissolving, filtration, tanks, evaporation, crystallization, drying, distillation, absorption, mixing and kneading, etc. After a brief description fo the process there follows a short description of the machines used and copius catalog illustrations and cuts of these machines.

Additional value is given to the book by various tables of constants and lists of references to books and magazine articles on the various subjects discussed. P. E. B.

## Book Notices

**Abriss der Lehre von den Erzlagerstätten.** Von Richard Beck, bearbeitet durch Georg Berg. Berlin, Gebrüder Borntraeger, 1922. 408 pp., illus., 7 × 10 in., paper, $3.60.

Doctor Beck intended to prepare an abridgment of his well known treatise on ore deposits which would be suitable as a college textbook and a survey of the principal information on the subject for use by geologists whose chief interests lie along other lines. He had corrected and annotated a copy of the third edition of the treatise, when his death in 1919 made it necessary to entrust the preparations of the present work to Mr. Berg, one of his earliest assistants.

This outline is approximately one-third the size of the original work, which it follows in plan and arrangement. Condensation has been effected by bringing together the less important occurrences, that are interesting for geological or other reasons, as examples in a general description of the corresponding groups of deposits. The number of ore formations has been reduced by combining certain groups, and the chapter on epigenetic deposits has been shortened.

**Continuous Wave Wireless Telegraphy.** By B. E. G. Mittell. (Pitman's technical primers.) Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1922. 100 pp., illus., 4 × 7 in., cloth, $0.85.

An introduction to radiotelegraphy from the engineer's point of view. It avoids the use of mathematics and plunges directly into the subject without a

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preliminary discourse on electricity or the development of mechanical analogies. Special attention, so far as space permits, is given to the Poulsen arc and to the construction of tall aerial structures, and useful references to important papers are given throughout the book.

**General Economic Geology.** By William Harvey Emmons. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 516 pp., illus., 6 × 9 in., cloth, $4.

An introduction to the study of mineral deposits, for students who have a knowledge of the elements of general geology and mineralogy. It embraces the geology of mineral fuels, structural materials and other non-metals, and of the metals.

The first chapter includes introductory matter, definitions and an outline of the classification of mineral deposits. It is followed by a treatment of coal, petroleum and the solid bitumens and a more detailed discussion of the classification and genesis of mineral deposits, which is succeeded by sections on non-metals and metals. Numerous footnotes give the principal sources of information on each topic.

**Introduction to Electrodynamics.** By Leigh Page. Boston and N. Y., Ginn & Co., 1922. 134 pp., 6 × 8 in., cloth, $2.

The object of this book is to present a logical development of electromagnetic theory founded on the principle of relativity. So far as the author is aware, the universal procedure has been to base the electrodynamic equations on the experiments of Coulomb, Ampère and Faraday, even books on the principle of relativity going no farther than to show that these equations are covariant for the Lorents-Einstein transformation. As the dependence of electromagnetism on the relativity principle is more intimate than this covariance suggests, he believes it more logical to derive the electromagnetic equations directly from this principle.

The book covers topics appropriate for a one-year graduate course in electrodynamics and electromagnetic theory of light. A logical rather than a historical account of the science.

**Mechanical Stokers.** By Joseph G. Worker and Thomas A. Peebles. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 258 pp., illus., tables, diagrs., 6 × 9 in., cloth, $3.

The first book to treat the stokers as a separate unit. It treats the phenomena of combustion in relation to stokers, describes mechanical stokers and modern practice in stoker installation and use, and discusses the selection of stokers for different fuels and differing conditions. The authors have endeavored to give reliable unbiased opinions and facts from field experience in design, installation and operation.

**Metric System for Engineers.** By Charles B. Clapham. N. Y., E. P. Dutton & Co., 1922. (Directly-useful technical series.) 181 pp., 6 × 9 in., cloth, $6.

This book is not concerned with the controversy regarding the metric system. Its object is to give a full, practical explanation of the system as it is met in engineering calculation and measurement, for use by draftsmen, mechanics and engineers.

After an introduction explaining basic principles, the simple measures of length, area, volume, capacity and weight are discussed, with special attention to the usual measuring tools found in workshops and drafting rooms. Compound measures used in engineering are described, with the derivation of the corresponding British equivalents, and tables of the commoner engineering constants in British and metric units, and examples of the alteration of numerical constants in formulas when metric values are to be used.

**Organic Chemistry.** By Victor von Richter. Vol. 2. Chemistry of the carbocyclic compounds. Phila., P. Blakiston's Son & Co., 1922. 760 pp., 6 × 9 in., cloth, $8.

The first volume of this translation appeared six years ago. The translation follows the 11th German edition, prepared in 1912. No other book of its size gives such an exhaustive list of compounds, with outlines of the methods for preparing them and accounts of their important properties. The book is useful for reference, particularly when the large encyclopedias are not accessible.

**Principles of Electrical Engineering.** By William H. Timbie and Vannevar Bush. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 513 pp., illus., 5 × 8 in., cloth, $4.

This is a textbook for students of college grade, who have a knowledge of calculus and physics, and aims to provide a substantial first course in the subject which will present rigorously, yet in understandable form, the basic principles underlying modern electrical engineering. Special features are the stressing of the subject of the magnetic circuit; the use of the electron theory as a basis for explanation; the inclusion of the subjects of thermionic emission, conduction through gases, electrolytic conduction and high-frequency phenomena; a novel approach to the subject of the behavior of dielectrics and numerous live problems.

**Pulling Together.** By John T. Broderick. Schenectady, N. Y., Robson & Adee, 1922. 141 pp., 5 × 8 in., cloth, $1.

A discussion of current problems connected with the relations of capital and labor, with employee representation as the central theme. Doctor Steinmetz has contributed a brief introduction.

**Well-boring for Water, Brine and Oil.** By C. Isler. Third edition. Lond., E. & F. N. Spon, Ltd.; N. Y., Spon & Chamberlain, 1921. 259 pp., illus., diagrs., 6 × 9 in., cloth, $4.80.

Describes various methods of boring and drilling in search of water, brine, oil or minerals, including driven and bored tube wells; the Kind-Chaudron, Dru and Mather & Platt deep-boring systems; the American rope-boring system, and diamond-drilling. Methods of raising water are dealt with. This edition includes the methods developed during recent years.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

Positions of the Bureau are on file in the offices of the member societies of the Federated American Engineering Societies and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Mining Engineer.**—Graduate (E. M.). Experience in metal mining, milling and erection of plants in England. Seeks position with mining or prospecting company, intending to start operations in Russia, Siberia or Caucasus. Now resident in Russia. Age 30. IM-1587.

**Mining Engineer.**—Design and construction of coal tipples, power plants and general machinery. Surveying mapping and general coal mine development. Experienced draftsman in all work. IM-1588.

**Construction Engineer.**—Desires position with copper-mining Company as superintendent of construction or experimental concentration and flotation work. Knowledge of conducting experiments, making flow sheets and design work, including reinforced concrete design. B. S. in mining. Age 24. IM-1589.

**Consulting Work.**—Mining engineer, eight years experience in solving problems in ore dressing and concentration, especially flotation of difficult ores, will make tests by flotation, gravity concentration, cyanidation, etc., also assaying and analysis of ores, alloys, water, fuels, etc. Complete testing and chemical laboratories containing seven types of flotation machines,

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samples of practically every flotation reagent on the market, tables, jigs, grinding machinery, etc. IM-1590.

**Metallurgical and Chemical Construction Engineer.**—Sixteen years in plant construction and operation. Desires position with chemical or metallurgical plant as resident engineer or with consulting firm either in office or field. Married. Age 34. IM-1591.

**Mining Geologist.**—Will graduate from eastern college in June. Specialized in oil and gas geology. Two years practical experience in oil transportation. Age 24. IM-1592.

**Advertising.**—Chemist, metallurgist. Copy writer. Good knowledge photography, preparation of bulletins. IM-1593.

**Metallurgist and Engineer.**—Experience in purchasing, production, layout, forge shop, heat treatment, laboratory and research departments. Capable of assuming entire charge of malleable gray iron, semi-steel or steel foundry. IM-1594.

**Steel Sales Engineer.**—Metallurgist experienced in manufacture, testing, and fabrication of steel, and sales engineering. Position as sales engineer or assistant sales manager. IM-1595.

**Petroleum Geologist.**—Seeks position of responsibility. Age 37, married. Fair linguist. Experience in North America and tropics. IM-1596.

**Administrator.**—Engineer desires general management plantations, railroads, mines, etc., in tropics. Expert knowledge of Spanish, Latin-American resources, knowledge French, German. Experience negotiating concessions, contracts with Latin governments, business men. Can furnish complete staffs. IM-1597.

**Metallurgical Engineer.**—Experienced in heat treatment and mechanical treatment of iron, steel, and ferrous and non-ferrous alloys. Successful research record. Open for position either in research laboratory or in plant operation. IM-1598.

**Assistant Superintendent or Mine Foreman.**—Graduate. Underground experience in open-stope method of mining in Wisconsin, Kansas, Oklahoma, and Arizona. Age 30. Married. IM-1599.

**Metallurgical and Mining Engineer.**—Specializing in manufacture of iron and steel and allied industries and the raw materials used therein. Long experience in both operating and research work. Reports on mining properties and appraisement and betterment of plants. Open to consulting work in this country or abroad. IM-1600.

**Superintendent or Manager.**—Proficient in hydraulic mining and stripping. Past performance proves can secure maximum tonnage and lowest costs. IM-1601.

**Mining Engineer.**—Assistant or secretary to consulting engineer or mine manager. School of Mines graduate, with special training and experience in stenographic work and office administration. IM-1602.

**Metallurgist.**—Technical graduate, experienced in smelting of copper ores, specialty pyritic smelting. IM-1603.

**Instructor in Mining or Miling.**—Eleven years practical in mine and ore-dressing practice. Efficient graduate mining engineer wishes to enter the teaching field. IM-1604.

**Junior Engineer** with two years varied practice desires position in mining or milling work. IM-1605.

## Positions Open

**Mine Foreman.**—Bituminous coal-mining experience. Scientific management experience essential. State law prescribes that foreman shall have state certificate of competency and one requirement is that applicant shall have had five years experience in bituminous coal mines of the state, position limited therefore to men from Pennsylvania. V-355.

**Assistant Executive** with insurance experience. Knowledge of workmen's compensation law essential, also safety and conservation experience. Must be able to develop and supervise office. 28–32 years old. Apply by letter. With U. S. Government, Washington, D. C. V-488.

**Research Engineer** with insurance experience. Age 27–30. Must have done research work in an insurance company and be able to get up special reports on insurance; also collect and build up file. Government position. Apply by letter. Washington, D. C. V-496.

**Chemist** with practical knowledge of manufacture of aluminum sulfate. Man of experience to go ahead with commercial process. Apply by letter. New Jersey. V-622.

**Research Engineer.**—Ability to apply sound scientific principles and reasoning to analysis and solution of a wide variety of general technical problems demanding fundamental research. Problems mainly in general field of mechanical engineering, although many are typical problems of physics and chemistry, some requiring special mathematical ability. At least 5 years active experience in research along lines indicated above. Advanced scientific and engineering training, such as lead to advanced degrees in physics, chemistry and mathematics, with special reference to mechanics and thermodynamics. Sound knowledge of practical engineering problems and appreciation of various factors that must be considered in applying scientific analysis. State lines of engineering with which you are familiar and extent of acquaintance with other engineers in these lines. Ability to summarize scientific and technical papers and to write up technical material for publication is of importance, also ability to maintain cordial relations with other engineers engaged in similar lines of work. Apply by letter. State when available and salary. New York City. V-629.

**General Manager** for architectural terra cotta plant near Cleveland. Must have experience. Apply by letter. V-655.

**Research Chemist and Metallurgist.**—Technical graduate with broad experience in laboratory and research metallurgy and ore dressings. Knowledge of Spanish language not essential, but preferred. Knowledge of cyanidation of silver gold ores; also of concentration and flotation. Send full record of past experience, education and qualifications, state whether single or married and if married, whether applicant would wish to take family to Mexico. Attach photograph if possible. V-705.

**Manager** for branch stores of national organization, 24–30 years of age. Executive business ability. Knowledge of chemistry or pharmacy preferred. New York City. V-765.

**Mine Foreman.**—Three-year contract. Transportation paid both ways. South America, high altitude. Apply by letter. V-785.

**Mine Shift Boss.**—1920 graduate will be considered. Three men needed. Three-year contract. Apply by letter. South America, high altitude. V-786.

**City Engineer.**—Apply by letter. Kentucky. V-802.

**Mechanical Engineer** or high class master mechanic to take charge of foundry shops and machinery of large mining company operating in Mexico. Must speak Spanish and furnish good references. Prefer one who has held responsible position in mechanical department of large mine in Southwest or Mexico. Apply by letter. V-818.

**Salesman** to handle asbestos products, especially pipe covering. Knowledge of contracting and sales experience necessary. Apply by letter. Salary and commission. New Jersey. V-831.

**Graduate Mining Engineer** with 2 or 3 years underground experience as mine surveyor. Must speak Spanish. South America. V-859.

**Mechanical or Electrical Engineer** with some operating experience. Should have a thorough knowledge of physics, especially thermodynamics. Experience in operation and design of temperature and pressure instruments and flow meters is essential. Work in instruments control department covers design and control of large variety of instruments used in manufacturing automobile tires. Mostly laboratory work. Apply by letter. Ohio. V-924.

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**Chemists** (3).—Capable men, about 5 years experience. Apply by letter. Arizona. V–938.

**Mill Superintendent.**—Experienced man for 5000-ton plant. Sliming, gravity and flotation. Apply by letter. Arizona. V–940.

**Mine Foreman** (10).—Company starting 10 mines in Arizona wants men of about 10 years experience. Apply by letter. V–947.

**Sales Engineers,** chemical or mechanical, to handle state territories on a liberal commission basis. Company manufactures an alloy combining unusual wearing qualities as a bearing metal, remarkable acid resistance, and great strength. Metal has been on market for eight years and is widely used. Applications should state age, education, experience in detail, and choice of localities. A recent photograph is desirable. Wisconsin. V–1001.

**Engineer** with several years' analytical chemical experience in copper smelting. Apply by letter. Norfolk, Va. V–1005.

**Sales Manager** for roofing department, to take care of office correspondence. Preferably one who knows New England territory and something of building construction and merchandizing. Boston. V–1007.

**Engineer** with thorough knowledge of passenger traffic routing on railroads. New York City. V–1013.

**Designer and Draftsman** for structural steel building. Several months work. Apply by letter. Detroit, Mich. V–1020.

**Structural Steel Draftsman** familiar with making shop details. Age 25, four years experience. Newark, N. J. V–1030.

**Engineer** thoroughly familiar with chemical analysis work, hardening and heat treating of tool steels. Apply by letter. Massachusetts. V–1034.

**Oil Geologist** with reputation for work in Peru, to locate drilling on fourteen parcels. Apply by letter. Salary and expenses. V–1153.

**Graduate Mining Engineer.** Experienced in railroad location work, open-cut mining and mapping. Apply by letter. South America. V–1157.

**Mine Sampler.**—Recent college graduate capable of doing surveying and mapping. Must do neat drawing and lettering: man of right caliber will eventually be put into engineering department. Prefer young man, single, to work into position as mine shift boss. Knowledge of Spanish desirable. Apply by letter. Central America. V–1180.

**Mill and Cyanide Shift Boss.**—Thoroughly experienced and graduate of good engineering college. 400-ton cyanide mill, all slime, Allis-Chalmers and Hardinge tube mills, Dorr classifiers, 1800-lb. stamps, etc. Must understand and be experienced in technical cyaniding process, and also understand mechanical details of plant. Prefer single man with good speaking knowledge of Spanish. Must be in robust health, preferably not over 35 years of age. Apply by letter. Central America. V–1181.

**Assayer and Chemist.**—Should have laboratory experience in one of Western copper laboratories and be able to turn out work in large quantities. Virginia. V–481.

**Engineer** with flotation and concentration plant experience. New York City. V–677.

**Salesman.**—Firm handles mainly ash and coal-handling equipment. Prefer man who can finance himself for 2 or 3 months or who is handling a side line of plant equipment. Apply by letter. New York City. V–683.

**Shop Supervisor.**—To supervise small shop making concrete roofing and siding slabs. Take charge of production and when necessary design or sketch odd-shaped slabs from plans. Ability to read blue print sketches, etc. and a small amount of drafting experience desirable. Apply by letter. New Jersey. V–717.

**Engineer** who is familiar with heavy steel material (not structural steel) such as banks and heavy chemical equipment, from a construction and sales standpoint. Apply by letter Headquarters New York City. V–842.

**Engineer** familiar with magnesium and magnesium alloys, their properties, applications and market. Headquarters New York City. V–883.

**Metallurgist** familiar with iron and steel research work. Age 35. New York City. V–906.

**Tin Mill Construction and Mine Manager.**—Must speak Spanish. Tin experience desirable. South America, elevation 14,000 ft. Apply by letter. V–1015.

**Electrical Repair Man and Trouble Shooter.**—Graduate E. E. Must know Spanish. Single man preferred. Position will lead to foreman of repair shop. Apply by letter. Chile. V–982.

**Engineer,** 27–30 years of age, preferably with chemical training, develop as salesman for cyanide products. Knowledge of either electroplating industry or case-hardening and heat-treating of steel would be good ground work for this position. Apply by letter. New York City. V–711.

**Chief Mining Engineer.**—Maryland Bureau of Mines. Ten years practical experience as mining engineer in bituminous mines, needed, also practical and scientific knowledge of working, ventilation and drainage of bituminous coal mines and of noxious and explosive gases. Graduation from recognized school of mines will be considered equivalent of two years active practice. Salary $5000 per year. Full information may be obtained from Maryland State Employment Commission, 22 Light St., Baltimore, Md. V–1080.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Amer. Foundrymen's Assn.. | Rochester, N. Y. | June 5–9 |
| Inst. of Metals Div. A. I. M. E. | Rochester, N. Y. | June 5–9 |
| Assn. des Ingénieurs sortis de l'Ecole de Liége | Liége, Belgium | June 18–24 |
| Soc. Automotive Engrs. | White Sulphur Spr., W. Va. | June 20–24 |
| Amer. Assn. for Adv. of Sci.. | Salt Lake City, Utah | June 22–24 |
| Amer. Soc. for Test. Mats... | Atlantic City, N. J. | June 26–July 1 |
| International Chemical Conference | Lyons, France | June 27–July 2 |
| Congress on Industrial Chemistry | Marseilles, France | July 2–7 |
| 13th Intl. Geol. Congress.... | Brussels, Belgium | Aug. 10–19 |
| Iron and Steel Inst. | London, England | Sept. 5–7 |

## Meeting and Exposition in Liége

THE Congress and Exposition in celebration of the 75th anniversary of the Association des Ingénieurs de l' École de Liége has been postponed for one week. The formal opening of the exposition will occur on Sunday, June 18; technical sessions will be held on June 19, 20 and 21, and excursions to manufacturing plants and other places of technical interest will occupy the last three days of the week, June 22–24.

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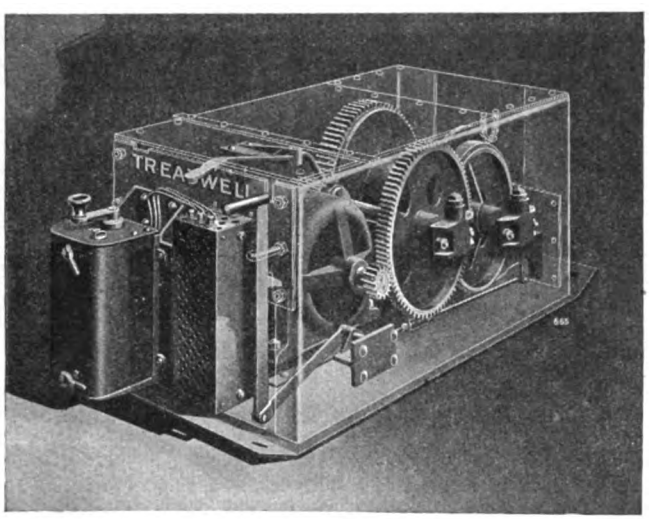
# Industrial News and Developments

**Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.**

## An Unusual Small Hoist

THE Treadwell Engineering Co., at Easton, Pa., has developed a self-contained, small portable hoist which is radically different from equipment heretofore available. This hoist is wholly enclosed in a heavy sheet-steel plate casing, mounted on a ½-in. steel sole plate. The unit casting forms the support for the drum and gear shaft bearings; the latter are electric steel castings, fitted with renewable bronze bushings and lubricated from a waste-packed oil reservoir. The controller box and resistance panel are, of necessity, mounted on the exterior of the




TREADWELL PORTABLE HOIST.

casing. All other mechanism and the motor are entirely enclosed. A removable door or cover is provided on the top of the casing to give easy access to the mechanism within.

The 8 by 12-in. drum has a capacity of 1500 ft. of ⅜-in. wire rope and the rated hoisting capacity of 1500 lb. at a speed of 100 ft. per minute. The standard motor is 5 hp., operating at 1200 r.p.m. The entire hoist measures 2 by 2 by 4 ft. 6 in. over all.

## Flexible Tubing for Mine Ventilation

THE Du Pont company is marketing a flexible, easily portable tubing for mine ventilation. This tubing, made of a special fabric called Ventube, is waterproof and fungus proof, and is highly resistant to acid and gaseous conditions; it is recommended for fire fighting and for other emergency use, as well as for the usual ventilation of a mine. Detailed description is given in a booklet published by the manufacturers, called "Efficient Mine Ventilation."

## Acid-proof Mine Pipe

DURING the past year, the American Wood Pipe Co., Tacoma, Wash. (Eastern office, 20 Church St., New York City) has placed on the market an acid-proof mine pipe. This pipe is made by banding fir staves with an insulated steel wire. A special pipe winding wire is covered with a specially prepared asphalt, which is then covered with cotton braiding. An attachment on the banding machine cuts a groove in the surface of the staves, the wire follows this groove, and is thus protected from mechanical injury. The outer surface of the pipe is dipped in hot asphalt, then rolled in sawdust and finished with a specially prepared binder coating which withstands any heat to which the pipe will be subjected in ordinary use.

## Industrial Notes

**Combustion Engineering Corpn.,** Broad St., New York, announces that the Power Plant Equipment Co. of Kansas City, Mo., will represent the Combustion Engineering Corpn. in the territory that covers in a general way, eastern Kansas, eastern Nebraska, western Arkansas, and western Missouri. The Kansas City address is 1002 Coca-Cola Building.

**The Combustion Co.,** 4256 Northwestern Ave., Chicago, has purchased, from the receiver for the General Combustion Co., the name, patent rights, drawings, patterns, trade marks and good will, including all contract records. Prompt attention will be given to inquiries for furnaces and spare parts.

**U. S. Dryer and Machinery Co.** has acquired the plant of the York Bridge Co. and the Cochrane Brass Foundry, at York, Pa., for the manufacture of double-shell rotary dryers. The general manager of the company is William J. Kuntz.

## Trade Catalogs

**Page Steel & Wire Co.,** Bridgeport, Conn.—Catalog No. 500. Hand Book on Page-Armco Welding Rods and Electrodes, 40 pp., describing and illustrating interesting developments in the welding field. Gives a short history of the manufacture of Armco iron, including analysis, and describes its application in welding rods and electrodes. Contains tables and other useful information.

**Hardinge Co., Inc.,** 120 Broadway, New York.—Description of new drum and scoop-type feeder designed to take care of reasonable circulating loads for the larger sizes of Hardinge mills.

**Jeffrey Mfg. Co.,** Columbus, Ohio.—Bulletin 365, describing and illustrating the Jeffrey 35-B Shortwall Coal Cutter. Particular attention is directed to improved features which make for lightness in weight, simplicity and ruggedness in design, ease of operation and control under all mining conditions.

**W. S. Rockwell Co.,** 50 Church St., New York.—Bulletin 241. Forging and Heating Furnaces. Contains an article on some fundamental principles that affect the quality and cost of forgings and other formed parts which are often overlooked in practice.

Bulletin 243. Stationary and Tilting Crucible Melting Furnaces, for melting brass and other non-ferrous metals with oil or gas fuel.

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# MINING AND METALLURGY

JULY 1922


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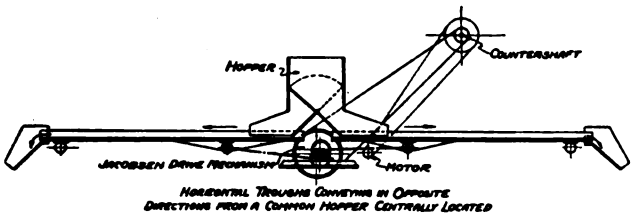

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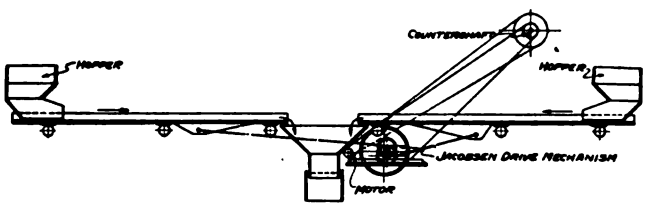

HORIZONTAL TROUGHS CONVEYING TOWARDS CENTER FROM TWO SEPARATE HOPPERS

DESIGN AND CONSTRUCTION
OF
MODERN AND IMPROVED EQUIPMENT
FOR
**COAL & ORE HANDLING PROBLEMS**

**HORIZONTAL & INCLINED**
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**FEEDERS**
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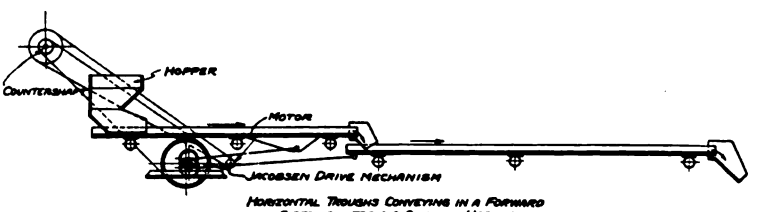
**DRYERS**



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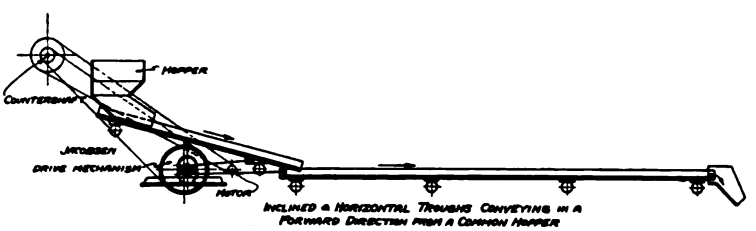

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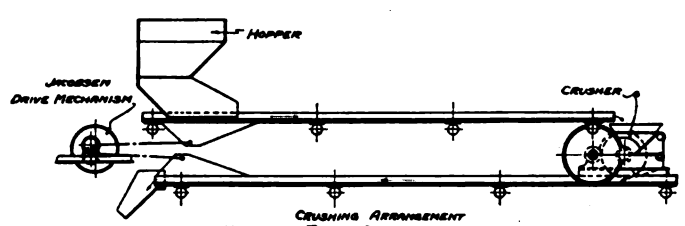
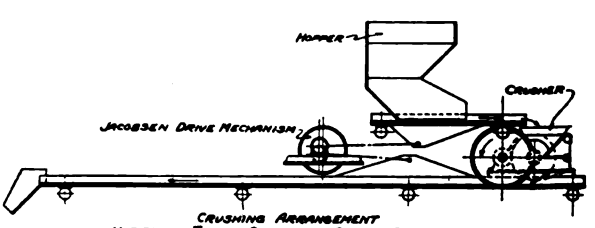


CRUSHING ARRANGEMENT
HORIZONTAL TROUGHS CONVEYING IN OPPOSITE DIRECTIONS



CRUSHING ARRANGEMENT
HORIZONTAL TROUGHS CONVEYING IN OPPOSITE DIRECTIONS

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# MINING AND METALLURGY

THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
29 West 39th Street, New York City, N.Y.

No. 187 JULY 1922


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## EDITORIAL

### Activity or Prosperity

IT HAS always been foreseen that there would come a time when there would be great industrial activity in the United States more or less regardless of the situation in Europe and the rest of the world. This would follow naturally from the needs to supply the deficiency of houses, to replenish depleted stocks of goods for general consumption, to bring the railways and their equipment up to the proper state of repair, and to provide additional transportation facilities. Looking further ahead, we could see an economic pressure toward installations for the improvement of efficiency in production, which might be exemplified by increased electrification, that would be in part a substitute for more railway lines, locomotives and cars, by virtue of carrying energy over wires instead of coal over rails.

This movement should not have begun until the readjustment of labor had been much further along, for it ought not to have been instituted on the basis of high costs. For three months now there has been swelling activity and it may be that this is a premature development of what had been foreseen. There is, however, a surprising new feature, *viz.*, the phenomenal expansion in the automobile manufacturing business, which there ought not to have been. It is important, therefore, to examine and analyze what is happening.

In the first place, there has been a great improvement in popular sentiment, antedating the physical upturn that began about April 1, which was manufactured and spread by diligent propaganda. This is reminiscent of the "sunshine" movement of the spring of 1919. The administration, approaching the fall elections, has wanted to have prosperity and an extinguishment of unemployment. Equally have state and municipal governments been anxious to drive away the specter of idleness. The soundness of the means was immaterial. If it were the modern custom to build pyramids, as in Egypt of yore, they would have put men to such work. Bankers and business



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men were in a frame of mind to aid and abet in anything, the liquidation of "frozen" credits being the one great thing to accomplish.

Thus, we have seen Washington parading every favorable little scrap of statistical data, even though it be in consequential, and the financial press waxing enthusiastic over such a thing as radiotelephony attaining a business volume of 20 million dollars (out of a national total of upward of 40 billion). The general tenor of the talk of the day is a reflection of the hypotheses that war is a sound basis for prosperity, that export trade is immaterial, that high prices are beneficial, and so forth. Let us now consider the facts, or anyhow some of them.

There is no inflation of the currency. On the contrary, our great accumulation of gold is impounded, rendered harmless, and the volume of outstanding Federal Reserve notes has been contracting. The ease in what is commonly called money is therefore a reflection of credit conditions. Manifestly, the recent tendency toward rising prices has nothing to do with the quantity of money, which means fundamentally the quantity of gold; and is merely a consequence of the conditions of supply and demand, the latter functioning through the credit that has thawed out. The thawing of the credits is shown by the contraction of the commercial loans by the banks, which were reduced from $9,326,000,000 at the beginning of 1921 to $7,271,000,000 at the middle of April, 1922.

The release of credit, therefore, furnished the basis for the operations that began with this year; in some directions a few months earlier. First it showed itself in a demand for bonds and preferred stocks which had become unduly depressed amid the exigencies of the general liquidation in 1920–21. It then became lent to speculative cliques who used it in bulling the stock-market generally. All of this evinced industrial depression, for otherwise the credit would have been required for the purposes of continuing production and carrying on physical business. The release of credits in the first place was of course a consequence of consumption gradually absorbing the accumulated stocks of commodities in which it had been tied up.

The same plethora of free credit was available for house building and automobile expansion and was so used. We may attribute, and probably correctly, the surprising upturn in the automobile business to three things, *viz.*, the passion of the people for the luxury, the delayed deflation of labor, whereby large classes have continued in enjoyment of inflated incomes at the expense of other people, and the easily available credit that has permitted the merchandizing of cars on time to a large and dangerous extent.

Even the building of houses under existing conditions has some dangerous features, although the building is justified by the shortage in the supply of houses, the great need for them, and the consideration that the building of houses is the creation of long-lasting wealth, while the building of automobiles is the conversion of labor and materials into machines that are quickly worn out. The recent program of house building has had manifestly a powerful speculative inspiration in the attraction of high rents. It is being carried on at something like 1.75 times the pre-war cost prices. Speculative investments in houses for rent under such a condition are likely to have similar results to investments in the stocks of industrial companies under the conditions of war profits. Moreover, the building program had had artificial aids in the form of excuses for a term of years from municipal taxation in some places, which is of course vicious. These conditions have already elicited expressions of alarm among bankers who are asked to loan money under such auspices.

The increase in business in the provision of railway equipment is undoubtedly sound, inasmuch as the railways have been constrained to supply very necessary deficiencies. It is noteworthy, however, that the railway enterprise in this respect is still very subnormal; in other words the railways are not going to capitalize any more than they have to at present costs.

The increased construction coming about in these ways reflects itself naturally in greater demands for many of the raw materials. The extent of such an increase as measured by sales and deliveries in recent months is likely to prove illusory, inasmuch as it has been to a more or less extent in order to make good depleted stocks of the materials in the hands of manufacturers, rather than being an index of increasing consumption. In other words, although 1921 was a bad year the actual consumption of the products of certain industries was greater than the demands upon producers indicated, the difference being obtained out of invisible stocks, which gradually were exhausted. We know positively that such was the case by the statistical study of certain industries, among them copper and zinc. The gradual consumption of surplus stocks, visible or invisible, and the calling upon producers for new supplies is of course a real improvement in their position. Moreover, the willingness of buyers to pay increasing prices for such supplies, when the market has previously been below cost of production, is a sound development.

In general, however, the rising tendency of prices that has been evinced during the last few months in the average index numbers is not something to be heralded with pæans of joy, taking a broad view of things, and in so far as such a tendency may be manifested in retail prices it is to be regarded with alarm. The general readjustment is by no means over. We may expect generally falling prices, both for commodities and labor, for a long time. There will be halts and upturns, just as we have been having of late, which may be of more or less degree and of longer or shorter duration, but if it be failed to recognize such undulations for just what they are there is great danger of

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mismanagement. Mischievous results are being already exhibited in the attitude of labor. The demands of the automobile industry and of building have created shortages of labor in certain places accompanied by advances in wages and even the payment of bonuses. This is inspiring to labor in general to maintain its position in resisting the inevitable, and thus we see the stolid persistence of the striking coal miners and the indignation of the railway workers at the proposed reduction of their wages.

Even more mischievous is the talk that is now in circulation about a general national shortage of labor owing to the restriction of immigration and the considerable emigration of foreign workers to their old homes. We have indeed a shortage of labor in certain industries, which is due to their excessive demands. I noticed recently a report credited to the Bureau of Public Roads to the effect that in 1921 something like 750,000 men were engaged in making, selling and repairing automobiles, while 1,000,000 men worked on the roads upon which the automobiles are to run. I do not know how true those figures are, but they afford an idea of the absorption of a large part of our workmen for what is essentially a pleasure-giving purpose. With the superfluity of persons attached to our coal mining, boot and shoe manufacturing, textile and other industries, that is well known, it is idle to talk about there being a general scarcity of workmen for the purposes of production. What is needful is to transfer men from the industries in which there is a surplus to those wherein there is more demand for them.

This will be a slow and painful task. It will be resisted by the unions who want to have things their own way, particularly the coal miners, railway operators and builders. They want to receive the services of all other workmen at a lower compensation but insist that they, themselves, shall continue to be paid at excessive rates. It remains for them to learn that everybody in this country is in the same boat, and that even pre-war wages can be held only by pre-war production. If production slips down below the pre-war quotient wages on the whole will be lower than the pre-war rates.

It is idle to think that the recent improvement in business has within the space of a few months solved and removed the great difficulties that culminated in 1921, and has among other things eradicated unemployment. It is unfortunate that we do not possess any good and prompt statistics on this important subject. The unemployment in the State of New York on May 1, 1922, was estimated at 600,000. An estimate of the same date by the Associated Press showed about 1,350,000 unemployed in 16 states of 43,000,000 population, which would indicate about 3,400,000 for the country as a whole. The number may have been reduced during May and June, but certainly not *in toto*.

It is well to bear in mind the difference between activity and prosperity. Prosperity means the condition under which people are getting ahead, making profits, saving a surplus and putting it into capital goods. On the other hand, there may be great activity under conditions keeping everybody employed, without their getting anywhere, although large classes may be having a good time in living from hand to mouth. Indeed, the thrifty accumulation of wealth under the capitalistic system is exactly one of the things to which not merely socialists, but also so-called liberals, have objected, as Professor Keynes has pointed out. It is to be feared that we are now experiencing a tendency to live wholly up to our income as many persons do in their private life. We know, of course, what happens from such a policy, whether it be on the part of an individual or an industrial corporation.

W. R. INGALLS.

## Churches and Industries

FROM time to time, leaders in radical movements seek to enlist the sympathy of churches on the ground that it is the duty of the church to encourage all efforts to relieve the oppressed, no matter where or how. Misunderstanding of the real character of these movements has even led some of our religious bodies to lend support or at least give tacit approval to un-American, uneconomical, and unsound views on social and industrial questions. Portions of the report of the Inter-Church World Movement in criticism of a large and most progressive industrial organization certainly did not reflect the view of any large number of the members of the churches that sponsored the movement. The activities of one of New York's prominent churches in extending the use of its pulpit to radicals of extreme views developed into such a grave misuse of church influence as to provoke censure and restraint on the part of higher church authority.

The Carpenter of Nazareth, during all His earthly career, showed only sympathy for all who labor and are heavy laden. There is no doubt that He expects His church throughout all ages to manifest the same spirit. The church cannot take an attitude of unconcern towards industrial life and be true to the teachings of its Divine Founder; but just in what way and through what agencies it can best contact with industrial life, in the complex social conditions of the present day, is not easy to determine.

Nearly a hundred years ago a spinning mill in France came, through inheritance, into the hands of a devout and earnest Christian, an adherent of the Roman Catholic faith. This man, who apparently before that time had little or no contact with the men and women who worked in the mines and mills of his country, was shocked by the irreligion and immorality he found among the workers in his mill, and immediately set himself to convert them. Finding personal appeal and personal example of no effect, he began studying how to improve their working conditions and home surround-

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ings, and this led to the formation of associations whose primary purpose was to better material conditions, but which, along with this, developed a very great influence on the moral and religious life of these people. Jacques Joseph Harmel's work is a splendid example of religion in industry, of a religion that undertakes to make men better in every way.

At the session on Americanization held at the Scranton meeting, an account was contributed of the work done by the Franklin Street Methodist Episcopal Church of Johnstown, Pa., of which J. Lane Miller is pastor. This church conducts as a part of its regular activities classes in English for Slovacs, Spaniards, Portuguese, and Mexicans, of which there are quite a number employed in the mills of this steel town. The work is largely conducted by volunteers, and in its development the opportunity is afforded and embraced to give the members of these classes in English correct ideas of American institutions and ideals. One evening each week a large number of young people go to the church at the close of the classes, meet with the persons who attend them, and converse in English. It is reported that in all these activities there has never been one unpleasant experience, but that, on the other hand, the combined attitude of both men and women of the church has given the foreigners the best view of American life that they have had while in America. The influence of this, coming in the formative stage of the newcomer's American life, cannot be overestimated.

The practical helpfulness of this church is not limited to Americanization. An extensive program of educational work—both vocational and cultural—is carried on regularly, excepting in the summer months, and affords to many who have had few advantages in the way of schooling or special training opportunities for self-improvement. The literary work is directed by the pastor's wife, herself a gifted writer, and the success of the work, after all, is due to the sympathetic understanding of the real needs of men and women by the pastor and his wife. Doctor Miller realizes, as did Jacques Harmel, that most people have wants that sermons do not satisfy.

Why are not the efforts of more churches in our Western mining communities directed to such work? Perhaps it is largely because of denominational competition, which certainly might be eliminated in these isolated communities with nothing but benefit. In most small mining communities there are several churches, each struggling to maintain a normal existence, and frequently doing this only with help from the parent churches working through "Home Missions." It is a regrettable instance of uneconomical, inefficient administration. Why cannot the community church with unified purpose, concentrated effort, and broader and more sympathetic outlook supersede these and develop churches whose influence will be strongly felt throughout the whole community and whose mission will be one of real helpfulness? Community work of a practical character has long been a part of the programs of many city churches, and in a few of the smaller residential communities, interdenominational community churches have been established and proved to be of real helpfulness. In rare instances have the churches in industrial centers, and especially mining camps, given much attention to such community work, and much rarer still are the instances where denominational lines have been erased and efforts united in one church organization, with a correspondingly increased influence. There is a wonderful opportunity for the churches which is too much neglected.

ROBERT LINTON.

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## Outlook for Lead

IT IS a striking fact that the world's annual production of copper, lead and zinc is, at present, roughly a million metric tons each. Forty years ago there was twice as much lead produced as either copper or zinc, but the lead production of the world has not kept pace with that of either of the other metals and today the possibility of producing copper is nearly double that of producing lead. For the past twenty years, no new lead district has been discovered in any part of the world, and additional lead can be produced only from the known deposits of low-grade ores, which cannot be mined at a profit at the present market price. In the face of this situation, more particularly since 1912, new major uses, like the storage battery and lead-encased cable, are making large demands on the world's output. Nearly half of the total is corroded to make paint and storage-battery oxides, the remainder being used for foil, shot, storage batteries, lead-encased cable, solder, sheet lead, babbitt, etc. A small amount is still used for lead pipe and plumbers' supplies. Ammunition accounts for a very small part of the total supply. Storage batteries, since the advent of automobile self-starters, have taken second place to paint in their use of lead. Radio receiving stations, each of which requires a storage battery, bid fair to rival motor cars in the amount of lead consumed.

In spite of the present general business depression, the lead industry is now more prosperous than those of all the other non-ferrous metals. This is due partly to the fact that although the war increased the production of lead, it did so at the expense of the higher grade ore reserves of the world but did not increase the capacity for producing, whereas its effect on both copper and zinc was to enormously increase the production capacities.

In 1909, Herbert Hoover wrote: "The likelihood of higher prices for lead is more encouraging than for any other metal, as no new deposits of importance have come forward for years, and mines are reaching con-

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siderable depths." This statement is probably truer today than it was in 1909; nevertheless, a much higher price cannot be too confidently anticipated, as such a price would undoubtedly lead to substitution in various directions.

The principal lead-producing states of the United States are Missouri, Idaho and Utah, which account for nearly 80 per cent. of the output. The mines of Idaho have a perfectly definite life without the probability of great extension. Missouri, particularly Southeast Missouri, has been heavily mined in the past ten years, but, in addition to the deposits now being mined, has extensive low-grade deposits which could come into use at a higher level of prices. The Southwest Missouri, Kansas and Oklahoma field is producing a substantial amount of lead, but it does so in connection with the production of zinc—about one pound of lead to four pounds of zinc—and its output therefore is largely tied up with the zinc production. Colorado, which at one time was one of the big lead-mining states, has now a very small output.

Outside the United States, Mexico probably has reached the peak of its production. Spain always has been a large producer and production shows no sign of falling off, although occasional labor and political troubles from time to time interfere with the output. Australia, the biggest potential producer outside of the United States, is in the hands of a union labor government, which makes production on a large scale at former low prices impossible. The great Broken Hill mines, with a potential output of 180,000 tons, produced less than 7000 in 1920 and only 56,000 in 1921. The production of Burma is increasing, but even at its present figure of 33,000 tons, it can have no very great effect on the market of the world.

We may conclude that during the next decade there is a probability of the price of lead being relatively higher than in the past, as compared to the prices of copper and zinc. CLINTON H. CRANE.

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## The Herrin Massacre

A COAL-MINING company operating at Herrin, Illinois, arranged to continue production in spite of the strike of its miners, which it had perfect right to do. Equally had perfect right, those men who chose to work for this company for this purpose. One day in the latter part of June, the striking miners besieged the works in something like a military operation against them. The workers surrendered, whereupon a large number of them were massacred with horrible circumstances. The account of this is worse than anything we read about during the Great War. It was most like tales of deeds by the Bolsheviks in Russia during their early days.

The authorities of the State of Illinois sat supinely during these events. Some inquiries were made in the region of horror, but it was reported from there that there was no need of sending troops, for peace prevailed. Peace prevailed by virtue of the mob having killed everybody whom it did not like. Subsequently a coroner's jury held an inquest upon the bodies of the victims and rendered the verdict that they had come to their death by fault of the operating company. I can not continue on this subject half so well as an editorial writer of the New York Sun, whom therefore I shall quote:

> The remarkable verdict of the coroner's jury at Herrin, holding the Southern Illinois Coal Co. responsible for the recent massacre, throws a further light on the attitude of the union miners toward the law. The attack on the mine, the shooting down of workers, the butchery of the prisoners, it seems, cannot be blamed upon the mob, but only upon the operators for bringing in "outlaw" workers to break the strike.
>
> That they have every right under the Constitution to work their own property, free from the dictation of labor organizations, does not matter. Their efforts to break the strike infuriated the miners and therefore the blood of the miners' victims is placed at their door. They must either yield to the demands of the strikers or be held responsible for all the violence that the strikers may do.
>
> That the people of the United States will never countenance such a doctrine as this ought to be evident even to the most radical of labor leaders. The Herrin massacre has made a host of enemies for the United Mine Workers. To attempt to place the blame on the operators can but make a bad matter worse. In fact, the union would do well not only to denounce those of its members who took part in the massacre, but to lend assistance in bringing them to justice.
>
> By so doing it would allay the suspicion which is gaining wide acceptance throughout the country that its leaders and the doctrines they inculcate tend to foment lawlessness and violence.
>
> It is a hopeful sign, then, that at least one union leader sees the danger and is taking steps to avert it. "Acts of disorder and violence only stir the public up against us and make bitter enemies for us in places where we must have strong friends," says Frank Farrington, president of the Illinois Federation of Miners. "Acts of destruction may appease the inflamed and angered miners, but cannot win any permanent success, and if victory depends on violence our cause is hopelessly lost."

There may be discerned a fine sarcasm in the interpretation of the words of Mr. Farrington. After such an event, labor leaders always talk that way. How could they afford to talk otherwise? It would be more to the point if they should express themselves properly to avert such events rather than to deplore them after they have happened. The Herrin massacre was merely worse than anything else, but generically it was in no wise different from the terrorism that labor unionists recently perpetrated in the building trade in Chicago, and what they have done in many trades in many other places.

The Herrin mob, if we may rely on the newspaper reports, was not composed of the sort of citizens who are frequently characterized as huns, bohunks and wops. The names of the persons appearing in the newspapers had an old-fashioned American flavor.

W. R. INGALLS.

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# Review of the Month

IN international affairs the great event of June was the meeting of representative bankers at Paris for consideration of the arrangement of a large loan to Germany. The conference dissolved in futility.

Following this abortive conference, the delegates to the parley at the Hague assembled there on June 15. America is not represented at the Hague, any more than at Genoa. The British view the conference seriously and have Leslie Urquhart, the highest authority on Russia, attending in an official capacity.

The Irish had their election and voted by strong majority in favor of the treaty with Great Britain, which was happy, but the general situation in Ireland is miserable. In China there were spectacular military and political events

Economically, Japan was in trouble. Conditions are becoming better in India, although no yet settled. Egypt has troubles still. Australia has a better chance for welfare, following the overthrow of its labor government early in April last. In Europe it is hard to discern any improvement except in Great Britain. Business in Great Britain has been slowly widening. The future of Great Britain, which is chiefly an industrial country, depends on finding employment for its 1,750,000 idle men.

Personalities figured largely in June. Lenin's health was represented as having failed so that the government of Russia has had to be turned over to a triumvirate. All of this has been denied. It is clear that some mighty events are transpiring there. The assassination of Doctor Rathenau in Germany is probably also an occurrence of portent. The murder of Field Marshal Wilson, in London, tended to increase anger in England against the Irish.

In the United States the attention of Congress was concentrated on the soldier bonus, the tariff bill and the subsidy for shipping. All of these projects are economically bad and are of the same nature, *viz.*, the allotment of a bounty to some classes of people, without consideration to the general national interest and welfare.

June was again a month of labor troubles. Everything so far has been confirmatory of the forecast that 1922 would be a year of great labor disturbances. The strike in the textile industry of New England is still on. There were new strikes in other industries all over the country. The railway workers (other than the operating forces) whose wages have been reduced by the U. S. Labor Board have voted in favor of a strike beginning July 1. This does not necessarily mean that there will be a strike. By the time this page appears the answer to that question will be known.

The coal strike pursued its course. By the end of June the production of bituminous had risen to about 5,500,000 tons per week, a rate far short of the consumptive requirements, which have been supplied for the rest out of the accumulated stocks. That the latter have held out so long can mean nothing but that industry as a whole is still on a subnormal scale. During June there was violence in several coal mining districts, and a massacre at Herrin, Illinois. In these ways this general labor trouble is running true to form.

From numerous industrial districts came reports of labor shortage and even of wage increases on account thereof. Among the districts thus affected were the lead-mining district of southeastern Missouri, the copper-mining district of Montana and the great silver-lead mining district of Idaho. In southeastern Missouri, a wage increase was granted. On the other hand, there are many industrial districts in which there continues to be great superfluity of labor and continued idleness. These conditions are simply a reflection of the general maladjustment.

In the metal markets, iron and steel continued strong, the production of ingot steel being maintained at a high rate. Copper, following the very large sales of May, was dull and its price shaded off a little from the maximum. This was quite normal, the buying of copper, by contract, occurring commonly in waves. The demand for lead also eased a little, but the price continued strong at 5.75 c. New York. The consumption of lead for paints, for storage batteries and for plumbing material, is very large, while production does not increase. Spelter after experiencing a rise to about 5.45 c., St. Louis, declined to about 5.30 c. The zinc industry is rather of the wastrel nature, and as soon as prices advance a little producers increase their output, mining in the Oklahoma field being conducted on the go-as-you-please principle.

An important event of the month was the decision of the Supreme Court of the United States, in what is referred to as the Coronado Case, to the effect that labor unions are liable for the industrial damages that they may cause by illegal acts. This was of course received with bitter feelings by the labor leaders. The American Federation of Labor held its annual convention in Cincinnati during June. It was reported that the total membership of the Federation is now 3,195,635, showing a loss of 710,893 during the last year.

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# Analyzing the Cost of Producing Anthracite

By S. D. WARRINER

President, Lehigh Coal and Navigation Co., Philadelphia, Pa.

ONE of the most, if not the most, difficult of the problems associated with the mining and distribution of anthracite is to get clearly into the minds of the consumers and of the editorial and reportorial writers in the public press the relationship between the cost of production, the price at the mine and the price that the consumer pays for his coal, delivered in the cellar. One sees in his morning paper a statement to the effect that out of the $12 or $13 per ton that his dealer charges him, the miner gets only $2 or even less, and he asks himself or the paper asks for him, "Who gets the difference?" Not infrequently the amount that the miner gets is given for run-of-mine bituminous coal while the price quoted is that of prepared anthracite, egg, stove, or chestnut, as the case may be, delivered to the bin of the consumer, and the difference stands out with all the more prominence; and it sticks in his memory with a persistency which no manner of explanation is able to efface.

A recently published official report for the year 1921 of one of the State Bureaus stated the total production of anthracite in *net* tons of 2000 lb., and included not only the output recovered by washeries from old culm banks and by dredges from creek and river channels, but also the colliery consumption; *i.e.*, the coal used by the companies in the operation of the collieries. This resulted in a total production of 90,509,075 *net* tons for which the labor cost was stated at $283,961,300, or $3.13 per net ton, equivalent to $3.50 per gross ton. This figure of $3.50 was immediately seized upon as representing the labor cost per gross ton of *fresh-mined commercial* coal. It is almost a hopeless task to try to correct such errors of statement in the first place, and, in the second place, to correct the misapprehensions that arise from them. As a matter of fact, the report was misleading in regard to the labor cost of the entire production shipped, as the coal used for colliery consumption should be deducted. Correctly stated, the report should have shown, calculated in terms of gross tons of 2240 lb., the legal weight in Pennsylvania, as follows:

| | |
|---|---|
| Gross production | 80,607,359 tons |
| Less colliery fuel | 8,757,137 tons |
| Commercial production | 71,850,222 tons |
| Total labor bill | $283,961,300.00 |
| Labor cost per ton | $ 3.952 |

The foregoing figures of tonnage are obtained from the State Department of Mines. Even these include the quantity recovered from culm banks by washeries, and consequently the $3.95 arrived at as the average labor cost is somewhat less than that actually involved in the mining of fresh-mined coal. Unfortunately, the figures of washery production and the cost of producing it are not available.

### Anthracite Production, Cost and Realization

The most recent official examination into the cost of and realization from anthracite production was that of the Federal Trade Commission in 1919, which covered six calendar years from Jan. 1, 1913, to Dec. 31, 1918. This report shows that the labor cost of producing fresh-mined commercial anthracite in November and December (subsequent to the final "war bonus" advance in wages) was $3.41 per *gross* ton. If to this be added the 17.4 per cent.[1] granted by the President's Commission in 1920, the labor cost since April 1, 1920, would appear to be a trifle over $4 per *gross* ton which agrees closely with the figure quoted in the preceding paragraph. Data compiled for the information of the wage negotiations committee in the spring of 1922 showed, however, that the labor cost based upon these figures was underestimated, as it was actually a little over $4.11. This figure may be accepted as correct within so small a fraction as to be practically free from error. To it should be added, in order to get the total cost of production, $1.05 per gross ton for supplies and 58 cents per gross ton for overhead, making the total cost (exclusive of Federal taxes) $5.74 per gross ton. The average cost of fresh-mined commercial coal for the region will probably not vary 5 c. a ton up or down from this figure.

Now as to realization. The prices for the domestic sizes of anthracite since Sept. 1, 1920, when the commission handed down its award, have ranged from $7.75 to $8.10 per gross ton, f. o. b. mines. When these figures are compared with the total cost as shown above it would seem that the gross margin on the mining operations is from $2 to $2.35 a ton. It must be remembered, however, that anthracite as it comes from the breaker is not all egg, stove and nut coal. Approximately 11 per cent. of the total output consists of

[1] Estimated average for all employees. See *Monthly Labor Review*, U. S. Bureau of Labor Statistics, October, 1920.

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pea coal that sells at little, if any, above production cost, and of from 25 to 30 per cent. of so-called steam sizes that sell at less than the labor cost alone.

Table 1 gives a statement showing the results of a normal yield from a total of 100 tons of the different sizes to which have been applied the *maximum* company prices obtained in 1921 and 1922:

TABLE 1.—*Results of Normal Field*

| | Tons | Mine Price | Realisation | Average Cost per Ton | Gain or Loss per Ton | Total Gain or Loss |
|---|---|---|---|---|---|---|
| Lump and broken | 5.4 | $7.75 | $41.85 | $5.74 | +$2.01 | +$10.85 |
| Egg | 12.6 | 7.75 | 97.65 | 5.74 | + 2.01 | + 25.33 |
| Stove | 20.1 | 8.10 | 162.81 | 5.74 | + 2.36 | + 47.44 |
| Chestnut | 22.2 | 8.10 | 179.82 | 5.74 | + 2.36 | + 52.39 |
| Pea | 11.1 | 6.00 | 66.60 | 5.74 | + 0.26 | + 2.89 |
| Buckwheat No. 1 | 14.2 | 3.50 | 49.70 | 5.74 | − 2.24 | − 31.81 |
| Buckwheat No. 2 (Rice) | 6.8 | 2.50 | 17.00 | 5.74 | − 3.24 | − 22.03 |
| Buckwheat No. 3 (Barley) | 5.0 | 1.50 | 7.50 | 5.74 | − 4.24 | − 21.20 |
| Boiler (Birdseye) or other | 2.6 | 2.00 | 5.20 | 5.74 | − 3.74 | − 9.72 |
| Totals and averages | 100.0 | a$6.28 | +$628.13 | $5.74 | +$ .54 | +$54.14 |

a Average realization.

From this it will be seen that, applying the *maximum* company prices to the entire production, the average realization, instead of being $7.75 or $8.10 a gross ton, is $6.28, and that the average margin instead of being $2 or $2.35, was 54 cents. From this margin must be deducted, before any funds are available as profits or dividends, such summer and trade discounts as may have been allowed and whatever contributions are made to the Federal Government in the way of taxes. Federal tax payments vary somewhat widely according to the earnings of the companies and the total amount is not known, so that no statement of the per ton average is possible. It is a safe guess, however, that the return on the investment in the last two years has ranged about 35 c. to 40 c. a ton. When it is considered that under present conditions the average investment in an anthracite property is from $8 to $8.50 per ton of annual output, it is clearly apparent that the average return in the anthracite industry is not more than 5 per cent. on the investment, which not only is not excessive but, because of the hazardous character of the business does not offer attractive features to capital seeking safe and profitable employment. Anthracite mining operations, in order to insure against the risks inherent in the industry should yield not less than 10 per cent. on the investment.

### ALLOCATING COSTS TO DIFFERENT SIZES

In order to fix a value on inventory coal some of the anthracite companies allocate the average cost to the different sizes, basing the allocation on the actual quantity of each size produced multiplied by the average mine price per ton for that size.

Upon this basis, the labor, supplies and miscellaneous expenses entering into the 100 tons of anthracite as given in Table 1 would be as shown in Table 2.

TABLE 2.—*Allocated Costs of Labor, etc., to 100 Tons of Anthracite*

| | Labor | | Supplies | | General Expenses | | Total Allocated Cost | |
|---|---|---|---|---|---|---|---|---|
| | Total | Per Ton | Total | Per Ton | Total | Per Ton | Total | Per Ton |
| Broken | $ 27.38 | $5.07 | $ 6.99 | $1.29 | $ 3.86 | $0.72 | $ 38.23 | $7.08 |
| Egg | 63.91 | 5.07 | 16.33 | 1.29 | 9.02 | 0.72 | 89.26 | 7.08 |
| Stove | 106.53 | 5.30 | 27.22 | 1.35 | 15.03 | 0.75 | 148.78 | 7.40 |
| Chestnut | 117.67 | 5.30 | 30.06 | 1.35 | 16.61 | 0.75 | 164.34 | 7.40 |
| Pea | 43.56 | 3.92 | 11.13 | 1.00 | 6.15 | 0.56 | 60.84 | 5.48 |
| Buckwheat No. 1 | 32.51 | 2.29 | 8.30 | 0.59 | 4.59 | 0.32 | 45.40 | 3.20 |
| Buckwheat No. 2 | 11.14 | 1.64 | 2.85 | 0.42 | 1.57 | 0.23 | 15.56 | 2.29 |
| Buckwheat No. 3 | 4.89 | 0.98 | 1.25 | 0.25 | 0.69 | 0.14 | 6.83 | 1.37 |
| Boiler | 3.41 | 1.31 | 0.87 | 0.33 | 0.48 | 0.19 | 4.76 | 1.83 |
| Totals and averages | $411.00 | $4.11 | $105.00 | $1.05 | $58.00 | $0.58 | $574.00 | $5.74 |

We then have as the mine cost of, say, a ton of Stove coal, $7.40, of which $5.30 is for labor. Remember, this is the *allocated actual* cost, and that against the $5.30 allocated labor cost for Stove coal must be set that of $2.29 for Buckwheat, $1.64 for Rice, and $0.98 for Barley.

Such a method of arriving at the cost is necessary, however, if anything like an understanding is to be had of what enters into the price of the coal which the consumer pays to his dealer.

With this before us we can show approximately what are the factors entering into the consumer's price, say in New York City. The cost of a ton of Stove coal at the mine is shown in Table 3.

TABLE 3.—*Allocated Cost of a Ton of Stove Coal at New York*

| | Per Gross Ton of 2240 Lb. | Equivalent in Net Tons of 2000 Lb. |
|---|---|---|
| Labor | $ 5.30 | $ 4.73 |
| Supplies | 1.35 | 1.21 |
| General expense | 0.75 | 0.67 |
| Total mine cost | $ 7.40 | $ 6.61 |
| Operator's margin as shown above is | $ 0.70 | $ 0.62 |
| Total f.o.b. mine price | $ 8.10 | $ 7.23 |
| Transportation to New York | $ 2.61 | $ 2.33 |
| Ferryage | 0.50 | 0.45 |
| Total cost to dealer | $11.21 | $10.01 |
| Dealer's cost of distribution, margin and profits | | 3.29 |
| Retailer's price | | $13.30 |

By the same process of reasoning, a ton of Buckwheat No. 2, delivered to the New York side of North River would contain the items of cost shown in Table 4.

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TABLE 4.—*Allocated Cost of a Ton of Buckwheat No. 2 or Rice Coal at New York*

| | Per Gross Ton of 2240 lb. | Equivalent in Net Tons of 2000 lb. |
|---|---|---|
| Labor | $1.64 | $1.43 |
| Supplies | 0.42 | 0.375 |
| General expense | 0.23 | 0.205 |
| Total mine cost | $2.29 | $2.045 |
| Operator's margin as shown above is. | $0.21 | $0.187 |
| Total f.o.b. mine price | $2.50 | $2.23 |
| Transportation to New York Harbor. | $2.47 | $2.20 |
| Lighterage | 0.35 | 0.31 |
| Total cost at tidewater | $5.32 | $4.75 |
| Dealer's cost of distribution, margin and profits | | $2.35 |
| Retailer's price | | $7.10 |

It will be observed that while the operator's margin is figured at 70 c. a gross ton, or 63 c. a net ton, in the case of Stove coal, it is only 21 c. a gross ton (18.7 c. a net ton) in the case of Buckwheat No. 2.

### STEAM SIZES NOT A BYPRODUCT

The "steam" sizes of anthracite are not, as claimed by some, byproducts in the manufacture of domestic coal, as are tar, ammonia and gas in the manufacture of coke, or the fertilizer products in the operation of a slaughter house. They are a part of the original product and their character is not different from that of the primal products—the domestic sizes—nor changed by the process of manufacture. They go through exactly the same processes of screening and cleaning as do the domestic sizes, and while they are sold below the cost of production, the revenue from them forms a part of the total realization and is not a recovery from byproducts that could be considered as reducing the cost of manufacture.

### VARYING COSTS AND REALIZATIONS

In the foregoing discussion, conclusions and deductions have been drawn from the average results as they obtain today. Naturally, not only do production costs vary in different parts of the field, but sales realizations with prices nearly as uniform as the product is in quality, produce somewhat widely different results. In the Northern or Wyoming region, the beds lie relatively flat, while in the Middle, or Lehigh region, and the Southern or Schuylkill region, they are severely folded and distorted and most of the mining operations are conducted on steep pitches, a decidedly different proposition from those on the relatively flat-lying beds of the Wyoming region. In general, it may be said, as a result of these conditions, that mining costs in the Wyoming region are less than in the Lehigh and Schuylkill, while, in the very nature of things, the methods necessarily employed in mining the steeply pitching beds produce a lower percentage of the "domestic" sizes, and a higher percentage of the small or "steam" sizes. Hence we have the somewhat anomalous situation of low cost production in some cases yielding the highest realization. Mining in the steep pitches will yield and does yield as low as 55 per cent. of "prepared" or "domestic" sizes, whereas in the more favored low-cost mines in the flat-lying beds of the Northern region the yield will be as high as 75 or 80 per cent. How this results in realization alone is shown in the following separations of 100 tons of mine-run coal into percentages of domestic and steam sizes at approximately average prices:

Steep-pitching beds will yield say

| | |
|---|---|
| 55 tons domestic at an average of $8 | $440.00 |
| 45 tons small at an average of $3 | 135.00 |
| | $575.00 |

Or an average of $5.75 per ton, whereas
The flat-lying beds will yield say

| | |
|---|---|
| 75 tons domestic at an average of $8 | $600.00 |
| 25 tons small at an average of $3 | 75.00 |
| | $675.00 |

Or an average of $6.75 per ton.

The average realization, as already shown, is approximately half way between these figures.

Norris has shown[2] that the cost of producing 90 per cent. of the total output of the anthracite mines was taken by the U. S. Fuel Administration as the "bulk line" on which prices were fixed. Now, as then, the margin between cost and total realization must be such as will enable all of those properties to operate whose output is necessary to meet the demands of the public, which is now insistent that its domestic coal bill shall be reduced.

That such reduction cannot be accomplished without a reduction in the cost of production, is clear, unless a material portion of the tonnage coming from the high-cost, low-realization, mines, is to be eliminated, until such time as prices may again be advanced sufficiently to enable their rehabilitation.

## Conservation of Scientific Knowledge

BY ALFRED D. FLINN

KNOWLEDGE inconveniently recorded is slow to come into use. Knowledge which cannot be quickly found when needed is to the man who seeks information as if it did not exist. Scientists and engineers are producing much information; a great deal of thought has been given to making it available. Results are still disappointing, especially in the engineering field, and many engineers do not know how to find their way about in the scientific fields. In most technical work,

[2] R. V. Norris: Anthracite Mining Costs. *Transactions* A. I. M. E. (1919) 61.

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all the information on a subject—and particularly the latest information—is desired quickly when an important project is in hand. There are books and periodicals and libraries, to be sure, but too often, for one reason or another, knowledge is concealed in them rather than revealed. Authors, editors and librarians can help by improving the production side of this knowledge machinery. The would-be users of knowledge should be better informed, as well as having more dependable facilities at their disposal. On the other hand, much information is not made generally usable because its producer does not know where to put it or has not the time to find the best place in the present confused state of affairs.

There is especially needed in our country, one institution which would have the master-key to all sources of scientific and technical knowledge and which could serve as a receiving or directing station for those who do not know the best place to send new information for filing or publication.

Such an institution, of course, must be very widely known and have the broadest of connections. During the past few years, American engineering and scientific societies have been creating an institution which can perform these functions if adequately financed—the National Research Council. With such resources as it has, the Council has made a beginning. Here is an opportunity for a man of large means to perform a great service to the country, and even to build a lasting monument, by giving to National Research Council an endowment for this purpose. A substantial addition to the endowment of Engineering Societies Library would further the same endeavor and would appeal especially to men connected with engineering and its related industries. This library is coöperating closely with National Research Council in this work, and at present engineering is most in need of improved facilities for making information quickly available. The objects to be attained in the course of time are:

1. Printing scientific and technical papers, reports and books in indexable form.
2. Competent abstracting of important new literature as it appears and suitable publication of such abstracts.
3. Indexing of new information promptly as it appears and means for distributing cards to libraries and other subscribers for a moderate charge, for such subjects as each subscriber may choose.
4. Indexing of previously published information to the extent found advantageous and feasible.
5. Preparation of harmonies or cross-indexes among the more important existing systems of indexing and abstracting.
6. Collection in N. R. C. building of full information about all comprehensive indexes of scientific and technological subjects in book or card form, bibliographies, abstracts and libraries, and about other collections of information and guides to information, including laboratories and research personnel.

In achieving the first five objects, the method would not be to concentrate into one place a huge super-library and card catalog, but rather to discover the best existing agencies for collecting knowledge and making it available—libraries, laboratories, abstract journals, scientific and technical societies—to learn how they should be used and how to direct inquirers to them, and to discover those branches of knowledge for which adequate provision has not been made. The function of the Research Council would be to discover all useful existing sources of information, including persons, to coördinate their endeavors, to encourage improvements, and to assist those that are worthy but which cannot be self-sustaining.

To the end contemplated, there would be assembled in the new permanent building of National Research Council, in Washington, a library of bibliographies and other sources of information, including a card catalog of these sources. A beginning has been made; development can proceed as rapidly as funds are contributed.

Further information may be obtained from Dr. Robert M. Yerkes, chairman of Research Information Service, National Research Council, Washington, D. C., or from the writer, who is chairman of the Division of Engineering, with offices at 29 West 39th St., New York.

## Mining and Metallurgical Exhibit in New York

ALTHOUGH the Eighth National Exposition of Chemical Industries, to be held at the Grand Central Palace, in New York, the week of Sept. 11–16, would by name indicate a chemical show, the exhibits of past years have had so many things of interest to mining and metallurgical engineers that some of them feel that the name should be broadened. Over four hundred representative concerns in this country will exhibit, more than half of which will have a vital interest to members of the A. I. M. E.

The Anaconda Copper Mining Co. and the New Jersey Zinc Co. have taken large spaces heretofore and have given complete exhibits of all of their products and byproducts, sometimes arranged in the form of material flow sheets. Similar extensive exhibits have been given by the International Nickel Co., the Monel Metal Co. and the British American Nickel Co.

The Dominion of Canada usually has a large exhibit, showing all of the commercial ores produced from its great mineral wealth and the Southern Railway shows the mineral resources of several states on its lines. It goes without saying that many of these minerals are tied up so closely with chemical products that such mineralogical exhibits are natural in this so-called chemical show.

The latest developments in milling machinery are always exhibited in the form of large-size working models generally operating on material much more refractory than the average mill man encounters.

Mining engineers and metallurgists, as well as mill men, who are visiting New York at that time may discover the solution of some of their difficult problems in the many and varied exhibits of this show.

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# Present Value in Its Relation to Ore Reserves, Plant Capacity, and Grade of Ore

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THE consideration of the present value of a mine is of great importance when planning for the operation of a property, and it is particularly so in the case of mines that have large ore reserves. At various times during the past 15 years, the writer has had occasion to make rather thorough studies of the subject, and has been greatly impressed by certain important points which these studies have brought out, points which, though they may be well known, are often lost track of in the rush to obtain low mining costs and high daily tonnage output. It is the object of this paper to present briefly, and in a general way, some of these points, and especially those which have to do with the relationship which (1) ore reserves and plant capacity, (2) grade of ore mined, and (3) ore losses in mining, bear to the present value.

Present value, sometimes called present worth or actuarial value, means the value today of the future earnings of an enterprise. Great industrial, manufacturing or railroad enterprises, if properly handled, go on indefinitely and their value is directly dependent on their estimated annual earnings. Mines, or oil properties, on the other hand, have an earning capacity only until the ore or oil is exhausted, and their present value is dependent not only on their annual earnings but also on their life, which is the length of the period over which they can produce at a profit. A mine, or an oil property, is a "wasting asset," while an established manufacturing business is not, or should not be. In other words, the present value of a mining property represents a sum of money on which there could be paid from operating profits a determined rate of interest, say 8 per cent., and in addition an amount which, if invested at compound interest as received, would at the end of the life of the mine pay back the present value.

In his "Wealth and Income of the American People," Walter Renton Ingalls says: "The fundamental principle of mine valuation is the present worth of an annual dividend accruing during the period of years corresponding to the life of the mine."

Much has been written on the subject of present value and on methods for calculating it. Hoover was one of the first mining engineers in this country to call particular attention to it, in his "Principles of Mining," and Fred Hellmann, in a paper written for the Institution of Mining and Metallurgy, in 1898, discussed the application of a present value formula to the developed mines of the Rand. It would be superfluous, therefore, in a short paper of this kind, to go into an explanation of methods of calculation.

It might be mentioned here that the mere calculation of the present value of a mine, based on estimates of ore reserves, profit per ton, and plant capacity, may lead to grave errors unless very careful and mature judgment is used in connection with such calculations, for there are many factors which, though they do not enter directly into the figuring, have a very great bearing. Among these factors are probable average selling price of the product during the life of the mine, the cost of plant or of added plant capacity, the effect of increased production on the market for the product, and physical difficulties, such as limited water supply, limited labor supply, etc., any one of which might make it inadvisable or impossible to have a plant capacity which according to present value figures might seem the best one.

## Ore Reserves and Plant Capacity

Of two properties having the same grade of ore and the same operating conditions, the one having the greater ore reserves is not always the one having the greater value, for the reason that plant capacity enters into the calculations. In some cases, the ultimate practicable size of the plant may be absolutely limited by physical conditions, labor situation, market conditions, or other causes.

Ore reserves can be made valuable only by building, or arranging for, a reduction plant to handle them, and the measure of their value is very largely dependent on the capacity of the plant. After a certain point has been reached, added ore reserves may mean little or practically nothing so far as present value is concerned, unless plant capacity can be increased.

The life of a property depends on its reserves of profitable ore and on the size of its treatment plant, and the larger its treatment plant and consequently

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the shorter its life, the greater will be its present value relative to the estimated total operating profits, assuming, of course, that the plant has been paid for.

Generally speaking, the present value of a mine increases with its ore reserves. However, with a given plant capacity designed for the treatment of a certain tonnage of ore blocked out, further increase in reserves does not increase the present value nearly as much as might be supposed. As a general rule, reserves which give a life of about 30 years are found to be the limit beyond which the present value is not greatly added to unless plant capacity is increased. With the same ore reserves, however, the difference between the value of a property having a plant capacity that would give it, say, a 60-year life, and the value of the same property if its plant would give a 30-year life, is very marked. The figures in Table 1 will emphasize and make clearer the above remarks.

TABLE 1.—*Effect of Plant Capacity and Ore Reserves on Present Value*

| Ore Reserves, Tons | Plant Capacity, Tons per Day | Life, Years | Profit per Ton | Annual Profit | Total Operating Profit Over Life | Present Value | Per Cent. of Total Operating Profit Represented by Present Value |
|---|---|---|---|---|---|---|---|
| 26,000,000 | 5,000 | 15 | $2.00 | $ 3,500,000 | $ 52,000,000 | $ 27,700,000 | 52.3 |
| 52,000,000 | 5,000 | 30 | 2.00 | 3,500,000 | 104,000,000 | 36,700,000 | 35.3 |
| 104,000,000 | 5,000 | 60 | 2.00 | 3,500,000 | 208,000,000 | 42,200,000 | 20.3 |
| 104,000,000 | 10,000 | 30 | 2.00 | 7,000,000 | 208,000,000 | 73,400,000 | 35.3 |
| 208,000,000 | 10,000 | 60 | 2.00 | 7,000,000 | 416,000,000 | 84,400,000 | 20.3 |
| 208,000,000 | 20,000 | 30 | 2.00 | 14,000,000 | 416,000,000 | 146,800,000 | 35.3 |
| 208,000,000 | 40,000 | 15 | 2.00 | 28,000,000 | 416,000,000 | 221,600,000 | 52.3 |

NOTE.—All Present Value figures in this paper are based on 8 per cent. dividend, and on 5 per cent. interest on the amortization fund compounded annually.

It will be seen from these figures that the shortest life shown, 15 years, gives the greatest present value relative to the total operating profits, and that even with such a short life the present value represents only a little over half of the total operating profits. It is of interest to note that to consider the total estimated operating profits alone, without figuring the present value of such profits, would give a very erroneous idea of the value of the property.

It will be seen also that to double ore reserves from, say, 104,000,000 to 208,000,000 tons without adding to the plant, and thus doubling the life, would add only about $11,000,000, or 15 per cent., to the present value, equivalent to only about 11 cents per ton of added ore. On the other hand, to double the size of the plant for 104,000,000 tons of reserve, from 5000 tons per day to 10,000 tons per day, and thus reduce the life from 60 to 30 years, would add about 75 per cent. or about $31,000,000 to the present value, from which addition the cost of added plant would have to be deducted, and would increase the annual profits from $3,500,000 to $7,000,000.

The figures of 208,000,000 tons of ore reserves are included to show what enormous differences can be made in present value, and in annual profits, by increasing the size of the plant in cases of mines having very large reserves, and what comparatively very small differences are made by great increases in ore reserves, if plant capacity is not increased to take care of such added tonnage.

No matter how much the ore reserves are increased, the annual profits will remain the same unless the size of plant is increased also, but with no increase of ore reserves annual profits will increase more than proportionately with increase of plant capacity—more than proportionately because costs will usually be lowered when greater tonnage is handled.

## GRADE OF ORE MINED

In studying the subject of ore reserves and their present value, one point which stands out as being very important, and which is not always given consideration commensurate with its importance, is the question as to whether or not the ore reserves can be divided into two or more sections or large blocks of different grades, and if so, whether or not the higher grade portion or portions can be mined separately. Nearly always only the average grade of the total ore reserves is considered, although it might make a huge difference in the value of the property to the owners or shareholders if arrangements were made to mine the higher grade portion first, so as to pay them back their capital investment as quickly as possible.

Managers and superintendents often are quite satisfied if the grade of the ore mined keeps up to the average of the estimated reserves, and superintendents in order to make tonnage, and thus hold down costs, have at times been known to mix non-payable ore in considerable quantity with higher grade ore so long as the average was up to estimates, not realizing that such a procedure actually reduced the profits.

When the size of the plant of a property, for various reasons, is fixed or limited, the sending to the plant of ore of lower grade than is absolutely necessary is a waste of plant capacity, and plant capacity costs money.

When it is possible, sometimes even at a considerably higher mining cost, to mine first and separately a higher grade portion of an orebody, it is nearly always advisable to do so, and in the case of very large low-grade mines it may be strongly advisable to do this, even if it means the eventual loss of large tonnages of ore on which a small operating profit could be made. Such mining might be called "selective mining," not in the ordinary sense of the term, but on a huge scale.

Again, perhaps it will make the subject clearer to go into figures, which, in connection with this question of grade of ore mined, are sometimes astounding when applied to large tonnage properties. Let us assume

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the case of a mine having total ore reserves amounting to 300,000,000 tons, which it is estimated will yield an average operating profit of $2.50 per ton, and that these reserves could be divided into two parts; one, say the hanging-wall portion, amounting to 200,000,000 tons which would yield an average profit of $3 per ton, and the other, amounting to 100,000,000 tons which would also give an average profit of, say, $1.50 per ton. Let us assume: (1) that the ultimate practicable limit of plant capacity is 10,000 tons per day, or 3,500,000 tons per year, and (2) that it is 15,000 tons per day, or 5,250,000 tons per year. The figures in Tables 2 and 3 show the present value of the property if only the higher grade portion of the reserves is considered, and the present value of the total reserves if the higher and lower grade portions are mined together.

TABLE 2.—*Ultimate Limit of Plant Capacity 10,000 Tons per Day*

| | Tons | Profit Per Ton | Total Operating Profit Over Life | Life, years | Annual Operating Profit | Present Value |
|---|---|---|---|---|---|---|
| High grade portion... | 200,000,000 | $3.00 | $600,000,000 | 57 | $10,500,000 | $126,000,000 |
| Total ore reserves..... | 300,000,000 | 2.50 | 750,000,000 | 86 | 8,750,000 | 107,900,000 |

TABLE 3.—*Ultimate Limit of Plant Capacity 15,000 Tons per Day*

| | Tons | Profit Per Ton | Total Operating Profit Over Life | Life, years | Annual Operating Profit | Present Value |
|---|---|---|---|---|---|---|
| High grade portion... | 200,000,000 | $3.00 | $600,000,000 | 38 | $15,750,000 | $176,500,000 |
| Total ore reserves..... | 300,000,000 | 2.50 | 750,000,000 | 57 | 13,125,000 | 157,500,000 |

It will be seen from these figures that with a limited plant capacity it would be much better to mine only the higher grade portion, and disregard the lower grade entirely, even if it meant that the lower grade portion could not be recovered at some very much later date. It is difficult to conceive, however, of a case in which the major portion of the low-grade ore could not be mined after all of the higher grade had been removed. The annual profits, it will be noted, would be in the neighborhood of $2,000,000 greater, over a period of many years, if the lower grade ore is left for the future and not mixed with the higher grade. The difference between the present value of the higher grade portion when considered alone, and the present value of the total reserves if the high and low grades are mixed in mining, amounts to about $19,000,000 in favor of the former.

These figures again illustrate the fact that added ore reserves do not always mean added value; in fact, they show that the value of a property may even be decreased by adding low-grade, though profitable ore, to the reserves if such low-grade ore is mined at the same time and mixed with the higher grade.

It might be mentioned that, under the assumptions made in the above illustration, even with a 20,000-ton plant capacity, the 200,000,000 tons of higher grade ore would have a greater present value than the 300,000,000 tons of mixed ore would have.

In connection with the question of grade of ore, superintendents and managers often dislike to leave low-grade ore behind, fearing that if they do it will never be recovered, but they fail to realize that to send low-grade material through the plant unnecessarily is wasteful, in that it uses up plant capacity, reduces annual profits and makes the enterprise as a whole less valuable to its owners. It is usually easier to mine the average grade than to arrange to mine the higher grade ore first, and sometimes the excuse is offered that the mining cost per ton of the latter would be higher. Such added cost, if it existed, would be in most cases, however, much more than balanced by increase in present value and by greater annual profits.

There are cases of large properties in which the higher grade ore is the ore nearest the surface, and where it is necessary to mine this higher grade ore first. As examples of this might be mentioned the secondarily enriched porphyry coppers of the western United States, where the secondary enrichment occurs just under the capping and where the grade decreases in depth. In most of these mines, whether stripping and surface mining or some underground caving method is used, it is necessary to mine the upper and richer portion in the beginning. This is an advantage so far as present value is concerned.

On the other hand, there are mines such as some of those in Chile, where the oxidized ore nearest the surface, which must be mined in the early years of the life of the property, is lower grade than the average of the whole mine and very considerably lower than the grade of the ore underneath it. This is a disadvantage, as it reduces the present value, and in estimating the present value of such a mine it is necessary to take into consideration not only the average grade of all of the ore developed, but the grade of the ore that must be mined during different periods of the property's life.

Ore reserves, whenever possible, should be mined in a way to give the property the greatest present value. This is justly due the shareholders or owners, who have invested their capital in the enterprise.

### LOSSES OF ORE IN MINING

In all cases of large operations there is a certain loss of ore in mining, which may amount to less than 5 per cent., or may amount to 15 or 20 per cent. To determine definitely the amount of such loss is very difficult, for the reason that it cannot finally be proved until an orebody, or a large portion of it, has been mined out. This question has been much discussed, especially in connection with the relative advantages of various caving methods.

In any method of mining that contemplates the

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caving of the capping, or of both the ore and the capping, losses of ore are usually due to the admixture of ore and waste, the waste, representing either the overburden or the material along the sides of the orebody, or both. Generally speaking, the ore is drawn from the stopes or caved pillars, until the admixture with waste is so great that the grade of the mixture is not profitable. This means that some ore must be left behind. Such losses may or may not seriously affect the present value of a property, depending on its life, on the grade of its ore, and on the cost of mining.

In the case of a property having a very long life, say 35 years or more, loss of ore would not greatly affect the present value, and might even have a beneficial effect if the ore loss meant even slightly higher grade or slightly lower mining costs for the ore extracted. As an example, let us assume a mine having 80,000,000 tons of ore developed, which would yield an average operating profit of, say, $1.50 per ton, and a treatment plant with a capacity of, say, 2,000,000 tons per year, and a consequent life of 40 years: The present value of the property would be $34,000,000 if all of the ore were recovered, or $32,700,000 if the ore lost in mining amounted to, say, 15 per cent., a difference of only $1,300,000, or approximately 4 per cent., in the present value. Such a difference would be equivalent to only 1.9 c. per ton (in present value) on the 68,000,000 tons recovered, and if by losing 15 per cent. of the ore the mining cost could be reduced by more than approximately 4.3 c. per ton, the present value would be greater than if the ore recovery amounted to 100 per cent.

As another illustration, let us assume a mine having 26,000,000 tons developed which would yield a profit of $1.50 per ton, and a treatment plant with a capacity of 2,000,000 tons per year and a consequent life of 18 years. The present value would be $22,000,000 assuming 100 per cent. recovery, or $19,900,000 assuming 85 per cent. ore recovery, a difference of $2,100,000, or approximately 10 per cent. in the present value. In this case, the difference would be equivalent to about 9.5 c. (in present value) per ton of total ore recovered, and the average mining cost would have to be reduced by approximately 11.1 c. per ton to justify the ore loss; or from another point of view it could consistently be increased by 11.1 c. in order to avoid the ore loss.

Now, let us assume a third case, in which the profit per ton is much greater, say $3, and with the same tonnage and plant capacity as with the last example. The present value of the property, assuming 100 per cent. recovery, would be $44,000,000; or, assuming 85 per cent. recovery, $39,800,000, a difference of $4,200,000 or approximately 9.5 per cent. in the present value. The difference would be equivalent to 19.4 c. (in present value) per ton of ore recovered, and the mining cost would have to be reduced by about 22.3 c. per ton in order to justify 15 per cent. ore loss.

These illustrations have been given to show, first, that in the case of properties having very low-grade orebodies, the present value is not greatly affected by loss in ore and may not be reduced by such losses, provided the mining method employed is cheaper than would be the case with a method that would recover a greater percentage of the total ore; second, that in the case of a property with a short life, the effect of ore losses on present value becomes more serious, even though the grade of ore is the same; and third, that the greatest effect on present value is in the case of a mine having high-grade ore and a short life.

Except when the grade of ore is quite high, reasonable ore losses do not greatly lower the present value and are not nearly as important as the question of plant capacity or the grade of ore mined, as will have been noticed from the previous examples. The effect of ore losses on present value is due to the shortening of the life of a property; they do not affect the annual profits unless accompanied by a dilution of the ore and a consequent lowering of grade.

### Time for Construction of Plant

It is of great importance to consider the effect on the present value of the time consumed in the construction of the plant to treat the ore from a mine; in other words, the effect of the deferring of dividends, due to time required for plant construction. A simple example probably would be the easiest way to illustrate this point.

Let us assume the case of a mine that has 105,000,000 tons of ore developed on which an average operating profit of $2 per ton could be made. Necessary funds have been raised for a plant with a capacity of 10,000 tons per day. The present value of the enterprise under different assumptions as to the length of time required for plant construction would be as follows:

| Time for Plant Construction | Present Value |
|---|---|
| Completed at present time | $73,800,000 |
| 2 years | 63,200,000 |
| 3 years | 58,600,000 |
| 4 years | 54,200,000 |
| 6 years | 46,500,000 |

These figures show that if the construction work should take three years instead of two years to complete, the present value of the enterprise would be reduced in this particular case by about $4,600,000, and if it should take four years instead of three years, the present value would be decreased by about $9,000,000. In such a case the expenditure of several million dollars more on the plant might be justified in order to hasten completion.

Often much time is lost in the consideration of processes or of plant design, and while it is wise to try to make an installation as perfect as possible, any loss of time due to what might be called over-cautiousness, or perhaps too great a fear of making mistakes, might be very costly.

The reason for these differences in present value is that the dividends which might have been received during the added time of construction would be deferred

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until the end of the life of the property; and in the case of properties having very long lives, such deferment would, for all practical purposes, mean a real loss, equivalent to the amount of the dividend.

### Sorting

In some cases, sorting of the ore, either underground or on the surface, may increase materially the present value of a property, especially when waste or extremely low-grade material can be sorted out and thrown away. This is particularly applicable to some classes of gold and silver mines, and sometimes to lead, zinc, or copper mines, where the mineral is not evenly disseminated through the gangue.

If sorting could be done without adding greatly to the operating costs, the output of a mill or smelter might be increased very considerably, which would mean a saving in plant capacity and a probable increase in annual profits, in spite of higher costs per ton.

There are some mines where it would pay to sort out and throw away a considerable amount of material carrying mineral, in order to reduce the silica (or iron) content of the product sent to a smelter, and in that way greatly reduce the smelting cost, or in order to make a self-fluxing product from an original ore which could not be smelted without the addition of costly fluxes.

Problems in connection with sorting are often very complicated and should be looked at not only from the point of view of what is best for the mine operation, but also of what is best for the transportation and reduction plant operations. Each case is a distinct problem and a careful study of any given case is often well worth while and may show that sorting would have an astonishing effect on the present value of a property.

As a simple illustration, let us take the case of a property under the following assumptions:

| | |
|---|---|
| Total ore reserves | 3,000,000 tons |
| Plant capacity | 150,000 tons per annum |
| Life of property | 20 years |
| Gross value per ton | $10.00 |
| Total operating cost per ton | $5.00 |
| Profit per ton (without sorting) | $5.00 |

The present value of the property, without sorting, would be $6,800,000.

Now let us assume that the ore is of such character as to allow the sorting out of 25 per cent., with a loss of 4 per cent. of the gross value, and that the total operating cost per ton of sorted ore would be $6.30. We would then have the following:

| | |
|---|---|
| Total ore reserves (sorted ore) | 2,250,000 tons |
| Plant capacity | 150,000 tons per annum |
| Life of property | 15 years |
| Gross value per ton (sorted ore) | $12.80 |
| Total operating cost per ton (sorted ore) | $6.30 |
| Profit per ton (sorted ore) | $6.50 |
| Profit per ton (original unsorted ore) | $4.87 |

The present value of the property, assuming that the ore was sorted, would be $7,700,000.

In the above example, the advantage of sorting is not in the operating profit per ton of original ore, which is really lowered by sorting, but is in the reduced life of the property, which in turn increases the present value.

Many more illustrations could be given, but as stated above, each case is a distinct problem and should be studied individually in order to ascertain to what extent the value of a mine might be affected by sorting.

### Purchase of Outside or Adjoining Properties

Mining companies, through fear of competitors or of undesirable neighbors, or fear that the price may be increased if they wait, often purchase properties adjoining their own, or isolated from it, even though the mining of ore from such properties may not be advisable or possible for 10, 20, or 30 years. Such purchases sometimes prove to be much more costly than might at first be supposed, for the reason that as long as they are not utilized they are what might be called "frozen assets," and the interest which might have been earned on the price paid for them is lost.

To pay a price of, say, $1,000,000 today would be the same as paying about $1,800,000 ten years hence; about $3,200,000 twenty years hence; or $5,700,000 thirty years hence, assuming an interest rate of 6 per cent.

At the beginning of operations of a large company, prices of property in the vicinity often are much higher than they are later on. Also, after a company has been operating successfully for many years it is easier and cheaper for it to raise funds, while in the early stages of its existence this is often very difficult and costly.

As an illustration, we might take a case of a large company which had more than ample ore developed in its own property, but which purchased for $1,000,000 cash an adjoining property containing about 7,000,000 tons of ore, on which an operating profit of $2 per ton could be made. The plant capacity of the company was 10,000 tons per day and its own ore reserves amounted to 175,000,000 tons, on which an operating profit of $2 per ton could be made. The present value of the 175,000,000 tons would be about $82,600,000, while the present value of the 182,000,000 tons after the adjoining property was purchased would be only $83,000,000, or but $400,000 more. In this case the property purchased was not worth the price paid, even though it had a large tonnage developed, unless an addition was made to the plant to take care of its tonnage, and then the cost of such a plant addition would have to be deducted from the profits or added to the purchase price.

There are cases, however, in which it may be necessary to buy adjoining properties, even though they may have no value from a point of view of ore tonnage, in order to give more room for a company's operations, tracks, etc., or to protect a company from possible damage suits due to the caving of a neighbor's ground.

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or for other reasons. In such cases the price paid should depend largely on how soon the company's operations would interfere with the property or be interfered with by it. If not for many years, the interest which would be lost on the amount of the purchase price should always be considered.

### Summary

To sum up: The present value of a mining property is dependent on several very closely related factors, the principal ones being its ore reserves, its plant capacity, and its operating profits per ton.

Increase in ore reserves, after a large tonnage has been developed, may mean very little increase in present value, unless the plant capacity is also increased. On the other hand, increase in plant capacity, and consequent shortening of the life and increase in annual profits, has a very marked effect on the present value, even if there is no increase in ore reserves, but the cost of the addition to plant, of course, must be deducted from the figured increase in present value.

The effect on the market conditions and on the price of the product should be considered in connection with a proposed increase in plant, especially in the case of very large operations; also the physical conditions at the property and the labor supply.

The average grade of ore mined has a very important bearing and should be given careful study, especially when the size of the plant is limited. Where possible, the higher grade portion of a mine should be worked out first, in some cases even when it might mean higher cost.

Dilution of the ore by the admixture of waste from the capping or from the walls may greatly reduce the present value, even though by allowing dilution the mining cost may be made very low. Dilution of the ore means reduced output, and usually reduced annual profits, and is a waste of plant capacity which can only be justified by a consequent reduction in costs sufficient to offset it.

Reduced operating costs per ton should mean increased profits and higher present value, but this is not always the case, as sometimes lower costs are obtained by mining lower grade ore than is necessary or advisable.

Losses of ore in mining may or may not seriously affect the present value; if the life of the property is great or if the grade of ore is low, they do not, while if the life is short and the grade high they may have a serious effect.

The present value of a mine may sometimes be greatly increased by sorting.

In general, the consideration of the present value of a mine is of great importance when planning for the operation of a property, particularly in the case of large mines, but the mere calculation of present value based on estimated ore reserves, profit per ton and plant capacity may lead to grave errors, unless careful and intelligent judgment is used in connection with each calculation.

## Safety Work and Medals

AT THE annual meeting of the Joseph A. Holmes Safety Association, on March 6, plans were laid for extending the work of this organization and for stimulating an interest in the subject of safety wherever there is a need for this kind of education. The Institute appoints one member of the Executive Council the Association.

It is planned to establish local chapters of the Association in every mining camp, mill or smelter where safety work is not now being conducted or where such chapters may be formed to coöperate advantageously with existing agencies. Already the Bureau of Mines, the U. S. Public Health Service, the Red Cross, the National Safety Council and operators of many properties are conducting educational campaigns. The Association does not desire to supplant these, but to coöperate with them and to carry the work into camps that have not yet been reached by other organizations.

First aid and rescue classes will be organized and guided in their work by competent directors, who revisit and retrain the members in order to keep them fit and ready for any emergency at any time. Accident prevention and sanitation will receive attention through lectures and the moving pictures of the Bureau of Mines. This is not new work that is being undertaken, but merely an extension of the work that has already proved of great value to both the owners and the workers in mines and metallurgical plants. In some districts, first aid classes already organized and trained have gone stale, due to the very fact that fewer accidents have occurred, and the Association hopes that it may re-educate these communities, bring them up to date and keep their interest constantly alert.

At the March meeting of the Association, five medals were awarded for distinguished service in rescue work as follows:

James Murphy and William Anderson, for hazardous risks in saving four lives at the Jackson-Walker Mine 11, Frontenac, Kansas, Nov., 2, 1918.

A. W. Spriggs, colored, who, following an explosion at North Mine Franklin Coal & Coke Co., Royalton, Ill., although he had never been in a mine before, set up a rescue station underground and saved the lives of a number of men overcome by afterdamp who would have died before they could have been brought to the surface.

W. H. Martin, for his attempt to rescue a man who was overcome by afterdamp during his first day's work underground, Parrish, Alabama, Nov. 23, 1920.

James Hudson, who lost his life in an attempt to save the life of another miner caught in the mine gases after an explosion at Black Diamond, Washington, July 10, 1920.

The Association is particularly anxious to obtain first hand evidence of distinguished service rendered, and will cordially welcome any information which members of the Institute may send to its secretary, Dr. David T. Day, 715 19th St., N. W., Washington, D. C.

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# Recent Developments in the Zinc Industry

By W. R. INGALLS

Consulting Engineer, New York City

DURING 1921, the Oklahoma mines dominated the American zinc-producing industry. They comprised the only group that could produce under the adverse conditions that prevailed. At the beginning of 1921, there were about 34 mills in operation in the Tri-state District, out of a total estimated variously at 150 to 200, and these were producing at the rate of about 5000 tons of blende concentrate per week. At the end of 1921, there were about 50 mills in operation. The Tri-state District rates about 80 men to the mine and mill, on the average.

## Smelting

The zinc smelters in 1921 experienced a disastrous year. All of them operated at greatly reduced capacity and probably most of them suffered loss in operations. Smelting costs came down to a considerable extent by virtue of drops in the price for coal, wage reductions and more efficient work, but these ameliorations were insufficient to enable the smelters to come out even. In the Illinois fields, wages at the end of 1921 had been reduced about 37 per cent. from the peak (middle of 1920), but coal continued to be very dear. The operation of works at a low rate of their capacity was a discouraging and expensive condition.

At the end of 1921, the zinc-smelting capacity of the United States was as follows:

| Class of Plant | Roasting Furnaces | Distillation Furnaces | |
|---|---|---|---|
| | Annual Capacity, Tons of Raw Blende | No. of Retorts | Annual Capacity, Tons of Roasted Ore and Calamine |
| Coal-fired..... | 561,600 | 82,828 | 804,100 |
| Natural-gas..... | 530,725 | 62,800 | 641,190 |
| Total..... | 1,092,325 | 145,628 | 1,445,290 |

For comparative purposes, these figures need some correction, inasmuch as certain smelters have no roasting furnaces at their works but treat ore roasted in other works. If allowance be made for such extraneous roasting capacity, the total for the country will appear to be about 1,300,000 tons, corresponding to about 1,100,000 tons of calcined ore, and leaving about 340,000 tons of distilling capacity to be supplied with calamine.

I estimate the above capacity as sufficient for the production of 625,000 tons of spelter per annum, besides which at least 9000 tons additional can be derived from the smelting of galvanizers' dross along with the ore. Anaconda's capacity for producing electrolytic zinc is about 66,000 tons per annum. Consequently the total zinc-producing capacity of the United States was about 700,000 tons (in terms of spelter). This is, roughly, twice the maximum pre-war rate of consumption.

## Direct Oxide Manufacture

The production of zinc oxide directly from the ore was affected adversely by the industrial depression, just as was the spelter business, but perhaps not to the same extent. Until the middle of 1921, the price for zinc oxide was 8¾ c. per lb. A reduction then was made to 7¾ c. per lb. in barrels and 7½ c. in bags. Zinc oxide is now largely shipped in bags, which is more economical to the producer than is shipment in barrels. The differential of ¼ c. per lb. allows only 75 c. for the 300-lb. barrel, while at the present time the actual cost of barrels for this purpose is something like twice that figure.

## Metallurgy

In reviewing the progress in the metallurgy of zinc it is ever difficult, if not impossible, to emphasize any particular thing as being an event of the year. Developments are always gradual. Our record of them usually reflects only the time when they begin to attract general attention.

*Roasting.*—One of the greatest rooms for improvement in the metallurgy of zinc is in blende roasting. We do not possess any really good mechanical furnace for the desulfurization of blende when use of the sulfur gases for acid making is also necessary. The Hegeler furnace does the work and American smelters employ it, with few exceptions, but after all it is only a semi-mechanical furnace.

During 1921, a trial was made at Cuba City, Wis., with a new design of the Wedge furnace. It came to an untimely and inconclusive end owing to failure of the stirring arms at the temperature to which they were subjected. Nevertheless, the indications from this run were encouraging.

The Central Zinc Co., at its smeltery at Seaton-Carew in England, adopted a full-sized unit of the Rigg blast-roasting system, with which, working on a

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small scale, extraordinarily good results were obtained in desulfurizing Broken Hill concentrates, the total sulfur being reduced to under 0.75 per cent. and the product being a sinter as porous as pumice which yields its zinc in distillation at a lower temperature and with much greater ease than does ordinary well-roasted concentrate.

There was litigation during 1921 between the American Zinc, Lead and Smelting Co. and the New Jersey Zinc Co., the latter alleging infringements of the Tucker patent for improvements in the mechanism in connection with the Hegeler roasting furnace. Late in the year, Judge Hale, of the Federal Court at Portland, Me., held that the patent was invalid, on the ground that it was a combination of old elements and old results with no new function.

*Distillation.*—Our distillation practice also has room for improvement. Among the directions to which attention usefully may be given are the matters of reducing the quantity of between-products to be resmelted and the introduction of the charge in briquetted form, which may accomplish surprising things in the ways of increasing the speed of the reactions, their degree, furnace capacity, etc.

I had occasion during 1921 to look into the subject of blue-powder production, and reported the results of this in a paper in MINING AND METALLURGY for April, 1922.

The benefit in distillation that may result from a blast-roasted sintered product has been previously referred to, and has been well established by the results at Port Pirie and Seaton-Carew. Coked charges and briquetted charges are other steps in the same direction.

Julius W. Hegeler did some interesting work at Danville, Ill., on the preparation of a charge for distillation by mixing coal and calcined ore and coking the mixture, producing a "zinc coke" which is loaded with all of the ore that it will carry. Using the local coal, it was found possible to prepare a product consisting of 34 parts coke and 100 parts calcined ore, this product being remarkably firm. In the retorts this behaves very well, and the accomplishment of the close contact of the ore and carbon in the coked charge is found to be very well worth while.

Naturally, we had no new furnace building in 1921, but rather was there more or less tearing down. The United States Zinc Co. began the dismantling of its distilling furnaces at Blende, Colo., and that plant will never be started again as a spelter-producing plant unless the type of furnace is entirely changed. This plant was built originally by engineers from Overpelt, Belgium, and was equipped with the Overpelt type of Rhenish furnace. Furnaces of the Rhenish type have been tried experimentally in other American works, but Blende has been the only plant wherein their use was the regular practice. In spite of alterations in the form of furnace front, and otherwise, the metallurgical results were never satisfactory.

*Electrolytic Extraction.*—The art of electrolytic zinc extraction made great headway during 1921, especially in the direction of improving the yield of zinc. At Great Falls the extraction formerly was not very good, although there was always a confidence that material improvement could be effected. This has been accomplished by a careful control of the roasting operation, wherein the temperature is kept at about 650° C., which prevents the formation of zinc ferrite to any great extent. If that be avoided, the percentage of zinc solubility may be expected to rise and, in fact, that is the case, with the results that zinc extraction at Great Falls has become pretty high even in treatment of low-grade ore. With high-grade ore (45 to 50 per cent. zinc) it may be very high.

I have always been of the opinion that the electrolytic process is best with a relatively high-grade ore, and I believe that all experience is confirmatory of that opinion. At Trail, the ore heretofore treated has been of relatively low grade in zinc and extractions there also have been rather poor, but the selective process of flotation has been introduced for the preliminary treatment of the ore and this is giving a higher grade of blende concentrate, with which the electrolytic plant is giving better results in the matter of zinc extraction.

The electrolytic process has experienced a good many improvements in details. The washing of the filter cakes is better done, with reduced loss of soluble zinc. Greater regularity in current efficiency is being obtained. Mechanical details are being improved. As I reported last year, the difficulties arising from impurities have been thoroughly mastered. It is no longer necessary to supply sulfuric acid to the process, but rather is it a question of getting rid of a surplus. If an electrolytic zinc plant be situated in a region where there is a market for sulfuric acid, the gases from the blende-roasting furnaces may be used for the purpose.

There are still great opportunities for improvement in the electrolytic process, which is to be expected, considering that the process has been in practical operation on a large scale for only about six years. One of the fields for improvement is the better treatment of the dross that is produced in melting the cathodes, which now we know to be rather inherent to the process and not to be corrected by the substitution of a closed furnace, such as an electric furnace, for the melting. The use of salammoniac in the melting furnace and liquating drum prevents this dross from being returned to the electrolytic process, for it is undesirable to introduce any chlorine therein.

Such matters as the above are receiving careful attention and are bound to be solved in one way or another. All of the experience is tending to show, however, that electrolytic zinc is certain to become a powerful factor in the zinc industry and a serious competitor of distilled zinc.

During November, 1921, the first section of the new plant at Risdon was completed and was put in operation

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in a successful way. The entire plant will be ready for operation during 1922. Its capacity will be for the production of 45,000 long tons of spelter per annum.

At Trail, also, extensions of plant are in process. In Italy, two small plants have been built, one at San Dalmazzo, the other at Vado Ligure. The Italians are giving earnest attention to this subject.

*Reverberatory Smelting.*—The Shasta Copper and Zinc Co. undertook to smelt the Bully Hill ore of Shasta County, California, in a reverberatory furnace, with the view to production of a copper matte and a zinc oxide fume suitable for trade purposes. The fume proved to be of inferior quality, partly owing to the presence of sulfates, in spite of repeated refining; and the extraction of zinc from the ore was low on account of high scorification of zinc, leading to large loss in the slag, which assayed only a little above 40 per cent. in silica. This experience confirmed previous knowledge to the effect that in order to keep zinc oxide out of a slag the latter must be either very siliceous, or very calcareous, or both. The slags, low in zinc, that are made in the electric furnaces in Trollhattan in Sweden, assay 50 per cent., and upward, in silica.

*Electrothermic Smelting.*—I have not heard of anything particularly important having transpired in the field of electrothermic smelting since the date of my last annual review. The production of spelter by this method in Scandinavia in 1921 was small, but this appears to have been due to commercial conditions rather than metallurgical. Trollhattan was in operation and at that plant the size of furnace was increased so that it became possible to smelt as much as 12,000 kg. of ore per 24 hr. successfully in a single furnace. Glomfjord remained uncompleted. In the United States, Doctor Fulton continued his experimental work on the treatment of a briquetting charge in an electric furnace operated intermittently.

## Disease and Accidents Huge Cost Factor in Coal Mining

THE monetary losses due to accidents and contagious diseases in the coal-mining industry of the single state of Utah average close to a million dollars per year, according to a report by Dr. Arthur L. Murray, surgeon of the U. S. Bureau of Mines. Doctor Murray believes that Utah is not exceptional in this respect, and that the conditions in many other coal-mining states are equally serious. A serious outbreak of a contagious disease, especially typhoid fever or small pox, during a period when the demand for coal is good may be the means of placing a large proportion of the operating force on a non-productive basis and so cripple a mine as to change it from a profitable undertaking to one showing a loss. Various statistics concerning accidents and disease in coal-mines of Utah are given in Doctor Murray's report, issued by the Bureau of Mines as Serial No. 2345.

## Honors to E. P. Mathewson

THE honorary degree of LL.D. was conferred on Edward Payson Mathewson by McGill University, at the Convocation in May. Mr. Mathewson was one of an illustrious company of five, composed of three notable Canadians and one other American, General Pershing.

During his stay in Japan, this spring, Mr. Mathewson was invested with the Third Order of the Rising Sun, by the Japanese Government, in recognition of his services in helping the development of the mining industry in Japan. He was elected also an honorary member of the Mining Institute of Japan. On Feb. 21, he made a speech before the Mining Institute, on which most interesting comments were made by Dr. M. Otagawa. The latter said:

Doctor Mathewson's speech has given me great pleasure. I believe, right at this moment, for three days, the annual meeting of the American Institute of Mining and Metallurgical Engineers is going on in New York. To this meeting I was invited, for they were going to publish on that occasion the paper I sent them last year. Having been prevented, however, I wrote them asking to read my paper and Secretary Sharpless wrote me that he would have the matter attended to by Mr. Winchell or some other gentleman. Just at this moment, we have been honored by Doctor Mathewson's visit and have had the rare privilege of hearing for two successive days some of the most interesting speeches we have ever had the pleasure to listen to.

We are quite flattered by the eulogy Doctor Mathewson has expressed on the result of the study accomplished by the professors of the Mining Faculty of the Tokyo Imperial University as well as by Doctor Omori on seismological survey. Nevertheless, we must be constantly mindful of the inevitable shortcomings and inferiority due to our shorter experiences and the comparatively imperfect equipments that are at our disposal. In my college career, seismology was taught as only a part in the course of geology by Professor John Milne and from this very beginning of the subject, effort and honest endeavor has brought us to our present position in the Science Department of the Tokyo University.

To hear such a high commendation on the equipment of our Alma Mater from a man of Doctor Mathewson's authority and standing cannot but be in the highest degree agreeable to us, because a large number of the Institute members are graduates from the Tokyo Imperial University.

Doctor Mathewson has expressed himself in the most flattering terms also on the achievement of the Furukawa people at the Nikko Copper Works. This is far from being anything that can compare in magnitude with some of those we see in the United States. It is 17 years since the series process of the electrolytic copper refinery was established at Nikko, the other two examples in the world being one at the Nichols copper works, Laurel Hill, N. Y., and the other at the Baltimore copper works, Maryland.

However, in the Nikko refinery, the tank room of multiple system was added afterwards. As to the Bessemer converters of the Ashio mine which turns out the anode of the Nikko works, they rank next to its American counterpart in the order of chronology, as they were built 30 years ago, next to Butte. Here, as in the case of the flotation process in our mills, we are indebted to the United States, particularly to the Anaconda works where Doctor Mathewson was presiding, for all the kindness that has been extended to our professional brethren.

Of Doctor Mathewson's praise of the smelting and refining process at the Kosaka mine, I can not but help heartily approving. At the Louisiana Purchase Exposition, also, the American jurors talked very highly about the success accomplished by the Kosaka people in the refining of the refractory ore. Now, again, the Kosaka mine received praise from Doctor Mathewson on its latest improvement, which, I should say, would redound much to its credit.

Doctor Mathewson's view about the advisability of drawing upon Western experience for milling and smelting of ores appeals to me as very reasonable. As I mentioned at the time of the visit of the members of the Institute party in 1911, we have been intent always on finding a method that could be properly applied

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to Japanese conditions with the best advantage, instead of blindly trying to rely on the Western system. Doctor Mathewson knows very well that a large number of the members of this Mining Institute of Japan are also members of the American Institute of the Mining and Metallurgical Engineers.

A most memorable international conference is now going on Washington. May the year 1922 be epochal! Doctor Mathewson has chosen this occasion to visit us. The addition of an honorable member to our Japanese Institute would mean the ever closer binding of these two great mining nations on both sides of the Pacific or, in other words, would mean the fabrication of the strongest copper cordage to keep and strengthen the traditional tie of friendship between the two peoples.

## American Welding Society Meeting

THE American Welding Society held an interesting annual meeting in April. It was reported that the committees of the American Bureau of Welding have been unusually active in aiding the scientific advancement of the industry and that local sections have been formed in eight large cities.

C. A. McCune was elected president of the society; W. H. Namack, T. F. Oechsle and W. A. Slack were elected vice-presidents, and W. E. Symons was reappointed as treasurer and chairman of the finance committee.

The society conferred honorary membership on Prof. Comfort A. Adams, founder of the society, and on Edmond Fouche, pioneer in oxyacetylene and gas welding.

## A. S. T. M. Methods of Sampling and Analysis of Coke

THE American Society for Testing Materials has submitted its Standard Methods of Laboratory Sampling and Analysis of Coke (D37–21) to the American Engineering Standards Committee for approval as Tentative American Standard, in accordance with the special procedure under which important standards in existence prior to 1920 may be approved without going through the regular process followed in new work.

These methods were formulated by Committee D–6 of the A. S. T. M. in coöperation with the American Chemical Society, the American Foundrymen's Association and the U. S. Bureau of Mines. The specifications are such that methods of coke analysis conform, so far as practicable, with methods of coal analysis, making due allowance for the differences in procedure that are desirable in the analysis for coke. They are in the 1921 volume of A. S. T. M. Standards. Copies may also be obtained from the American Engineering Standards Committee, 29 West 39th St., New York City. Price 25 cents.

The A. E. S. C. would be glad to learn the extent to which these specifications meet the needs of the industry.

## Bowie-Gavin Cracking Process

BECAUSE of certain statements that have recently appeared in the press concerning the so-called Bowie-Gavin "cracking" process, the U. S. Bureau of Mines has thought it best to make an official statement outlining the true situation regarding the experimental work that has been done up to the present time.

The process is designed primarily for the cracking of tars, heavy crudes, residuals, etc. It is possible that it may be applicable also to the recovery of oils from oil-soaked sands, oil-shales, etc., but no attempt has been made to perfect it along these lines, as it is not felt that extractions of this nature could be made profitably under present commercial conditions.

The process consists of cracking hydrocarbon materials that contain no gasoline or kerosene products, in a still of novel design, and producing a cracked oil yielding relatively large proportions of gasoline, kerosene, etc. It is designed to be continuous and the recovery of cracked oil is often as much as 85 per cent. by volume of the original oil used. The oil produced by the process contains a relatively high percentage of unsaturated products. Results to date have indicated that many of the carbon difficulties have been overcome.

Laboratory experiments have been carried on by the Bureau of Mines for a number of years, and within the past year an 8-ft. commercial apparatus has been constructed and operated intermittently at San Francisco. No claims have ever been made that the process has reached a commercial success; on the contrary, it is still decidedly in the experimental stage. Tests recently made indicate that, so far as the still is concerned, the remaining mechanical difficulties possibly could be overcome by continuous operation of the plant, but as this will probably require a larger amount of money than the Bureau of Mines will be able to expend, it is doubtful whether the Bureau will be able to carry the experiments to a satisfactory conclusion.

A bulletin covering the process and apparatus is being prepared.

## National Exposition of Power and Mechanical Engineering

ANNOUNCEMENT has been made of a National Exposition of Power and Mechanical Engineering to be held at the Grand Central Palace, New York City, Dec. 7–13, 1922. The exposition will follow the annual meeting of the American Society of Mechanical Engineers and it is expected that the exhibits will supplement the programs and discussions at the professional meetings of the Society. Requests for information and reservation of space should be sent to the offices of the managers, Grand Central Palace, New York City.

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# How the State Department Can Aid Foreign Oil Development

By LESTER H. WOOLSEY
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THE State Department can be of assistance to Americans in the petroleum business directly and indirectly. During the past few months, at the Arms Conference, it had a large hand in dealing with affairs indirectly affecting the oil problem. The conference has somewhat relieved the emphasis on naval strategy in relation to oil supply by limiting the number of naval vessels or the fleets of the Great Powers and in maintaining the "open door" in the Far East in respect of the development of the natural resources of that region by defining that policy in a nine-power treaty. The largest competitors of the United States in the petroleum field are parties to that treaty. The Department of State also has stood steadfastly for the principle of equal opportunity in the Dutch East Indies, Mesopotamia, and Persia.

The Department of State has been of indirect assistance in connection with oil problems by insisting on the recognition of treaty rights and other guarantees, such as most-favored-nation clauses, and mandate provisions.

I am not speaking as a representative of the Department of State, as I now have no connection with that institution, but my experience of several years as a member of the department and my practice since my resignation have given me opportunity to see the department from both the inside and the outside, and to measure its limitations as well as its resources.

## Limitations of State Department

Among the limitations of the department is one that is axiomatic and which many persons with large interests abroad overlook or misunderstand on account of its simplicity. The Secretary of State can act only through the written or spoken word. The applicant is prone to forget the proverb that "the pen is mightier than the sword." The department, of course, has no armed force at its command and no authority to direct or use one; when force is needed to protect or advance an American interest abroad, the appeal must go directly or indirectly to the President. The department has no retaliatory powers, except such as it may persuade another department of the Government, through the President, to exercise. It is limited largely to the use of logic in diplomatic correspondence or conversation.

The department is not in a position to assume the same responsibilities as a private individual or company. It cannot solicit directly a petroleum concession of a foreign government; it cannot enter, itself, or through another branch of the Government, into the business of petroleum exploration or exploitation in a foreign country either directly or through ownership of stock in private corporations; and it cannot obtain a concession on its own account and turn it over to an American concern to operate on shares. It is at a disadvantage, therefore, compared with certain foreign governments, particularly the British Government, which directly participates in the oil industry through the ownership of shares in companies.

The Secretary of State cannot enter into diplomatic intrigue or use unfair methods or follow an irregular procedure to obtain a concession or privilege for an American company in a foreign country. He must proceed on the basis of fairness and justice to all, even though other governments and private interests follow other practices.

The department cannot give support to an unconscionable concession, such as one covering the whole of the territory of a foreign country, nor can it espouse one obtained by foul means or questionable practices, as in exchange for assistance to revolutionists, by bribery, or by bad faith.

The Secretary of State cannot violate international agreements or domestic policies in giving support to an American enterprise. These agreements may be contained in treaties with foreign countries, which are the law of the land, or in diplomatic agreements, as to policies such as the "open door" and equal opportunity. He cannot go counter to the laws of the United States embodying domestic policies such as freedom of competition and commercial regulation of certain public utilities. The reason for this is obvious; if the Government supported a proposal presented to a foreign government which amounted to a monopoly, the foreign government would quite properly say "Why do you ask us to accept a project which is opposed to domestic policies of the United States and could not be established there?"

The Secretary of State cannot act without adequate information. In supporting a company abroad, he must be assured that it is of American nationality and

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control; that it is responsible and of honest purpose. A company that is organized in the United States but which is controlled by, or affiliated with, foreign interests does not appeal to the State Department as entitled to the same support as a bona fide American-controlled company. American companies and American capital should avoid being used as catspaws by foreign companies, if they desire the assistance of their Government.

While the department may obtain considerable data of interest to petroleum enterprises through the foreign service, such as foreign laws governing the development of petroleum and the organization of operating companies, imposition of taxes, charges, etc., the character of a foreign people and the stability of its government, it must depend for a large part of its technical information on the petroleum companies themselves or on "leads" furnished by them which it can investigate. The Department of State, therefore, should be in the closest contact with American oil companies. The department has no men abroad trained as petroleum geologists or engineers and it has never, so far as I know, used men so trained from other branches of the Government for the purposes of gathering technical information abroad in regard to exploitation of petroleum. I understand, however, that the British Government has done this to some extent in certain fields by attaching technical men as army officers to staffs of its foreign missions.

The foregoing restrictions on the Secretary of State may seem a formidable array of limitations to the assistance that the department can give to American concerns engaged in any line of endeavor abroad. The American Government is at a disadvantage in obtaining privileges for Americans in foreign countries, compared with foreign governments that have greater freedom of action and fewer scruples to overcome. It may seem that the department can be of little assistance in the opening of foreign oil fields to development by American companies, but the reverse is the case, when the department fully exercises its powers within the limitations mentioned.

### Restrictions of the Foreign Office

In all governments, particularly in democratic countries subject to popular and parliamentary criticism, the tendency is to act with over-caution and reluctance, and to hide behind any well-founded limitations available. Such an attitude is particularly true in the case of business matters which, because they involve relations with foreign countries, must be handled through the Foreign Office rather than through a commercial department of the Government.

A Foreign Office is apt to be bound by procedure and precedent long established in diplomacy and the natural tendency is to apply the same principles to business and trade. To illustrate, it is not in accordance with diplomatic courtesy to publish a diplomatic note without the consent of both the sending and receiving Governments and, therefore, a Foreign Office may hesitate to tell a business man what representations it has made to a foreign government on his behalf. For the same reason, it may hesitate to disclose the report of a legation on a matter of vital business interest to an individual. Again, it is often a practice in diplomacy to tie up one controversy with another and to consider the two together; thus the claim of one country against another may be made dependent on the settlement of the claim of the other country against the first. This makes for delay and inaction. Moreover, a Foreign Office may be engaged in secret diplomatic negotiations with a foreign government, say on the question of equal opportunity in a foreign field, and delay the consideration of business matters only remotely affected by the negotiations.

### Additional Assistant Secretaries Needed

A Foreign Office is often not equipped to handle business matters effectively and promptly, except in a general way, on account of lack of a distinct organization within itself whose function it is to deal with the general run of business matters. In many Foreign Offices there is a lack of men trained and experienced in the business world, as well as in the theory of foreign trade, and business administration.

Our own Department of State, for example, has no adequate means for an effective liaison with business men. The Foreign Trade Adviser's Office, which a year ago was distributed, for the most part, among various political divisions, should be strengthened; and the Assistant Secretary of State who has charge of trade affairs should be free to devote his entire time to those matters. In order to make this possible, one or two additional assistant secretaries should be provided for the department by Congress in the interest of the expansion of American business abroad. It should be appreciated—and this cannot be emphasized too strongly— that there are certain phases of American foreign business, particularly where it concerns or involves a foreign government, which can be handled only through the Department of State, since it is the only channel of official communication between the United States and a foreign country. In such matters, business men naturally and quite properly look to the Department of State for assistance—assistance unhampered by the impediments of diplomacy. International trade probably never can be entirely divorced from international politics, but international policies should, indeed in these days probably must, be formulated on principles of economics and commerce and not alone on principles of international law and diplomacy.

In fact, it may be doubted whether economic matters should be dominated at all by diplomatic policies and precedents. However this may be, there are many classes of business matters that involve no general policies and which clearly should be dispatched promptly

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without relation to the larger problems. An assistant secretary with all of his time devoted to commercial matters could see that such cases are expedited and not caught in the toils of diplomacy. Now the particular case of an individual American citizen or concern whose business interests need special and prompt assistance abroad must take its chance with the greater international problems, and is frequently pushed to the wall. The strengthening of the section of the department that handles these matters and its organization along the lines of a business house under an Assistant Secretary for Commercial Affairs, reporting directly to the Secretary of State and coöperating with the Department of Commerce, is sorely needed today to rescue purely business matters from the tide of large political problems now claiming the main attention of the Government. In short, business men like to feel that their Government will discuss matters frankly and freely with them when their interests are involved.

It may be said, however, that the foregoing remarks refer to commercial questions generally. There are certain classes of such matters which receive special attention in the department. For example, matters relating to oil are given centralized handling in the department and there is close contact with oil companies as well as with other departments of the Government.

### How the State Department Can Assist

The following statement in regard to the assistance that may be given by the Department of State to aid the opening of foreign oil resources assumes not only the full exercise of its functions within the limits already mentioned but the establishment of an efficient organization within the department for the handling of all such business matters.

As a basis of discussion, we may take a typical case in which, from the standpoint of the welfare of a foreign country having prospective oil territory and from the standpoint of an American company interested in the development of that territory, it would seem advisable to explore and operate for oil under a concession from the foreign government to the American company. What can the Department of State, imbued with a desire to assist an American concern to the utmost, do to obtain for it a proper concession?

The department, on its own initiative or at the request of a company about which it is satisfied as to nationality and reliability, can make inquiries of the foreign government as to whether it is desirous of having a serious exploration of its country for oil by a reliable American concern and of entering into a contract with an American company for the development of its petroleum resources. The department at the same time can explain the advantages, national and international, which might be expected to flow from such a relationship with a responsible American company. The department cannot obtain a concession on its own account and then try to turn it over to an American company to operate, or organize and promote a company for that purpose, or operate the concession on its own account. In short, an American company must be ready to step in and take over the concession; but the department, if it will, can take the initiative in opening the way for negotiations between the foreign government and the private company. It is understood that the department has done this and, in one or two instances, has failed to find an American oil company ready to enter the opening made for it.

If opportunity for American concerns to participate in the development of the oil resources of the country is closed in favor of its own or other nationals, the Secretary of State may follow the precedent set in the Dutch East Indian and the Mesopotamian cases and protest against this closing of the door, and if the American laws allow it, he can close the door of equal opportunity for the nationals of that country to participate in the development of the natural wealth of the United States. If those nationals have no interest in such participation, such retaliation will avail nothing for the advancement of the American company interested in foreign oil production; therefore, if the matter is to be pressed further, the Government must seek some other means of retaliation, possibly by legislation in Congress. This point was emphasized in my paper[1] last year.

Should the way for negotiation of an oil concession be opened, however, the Department of State can instruct its representatives abroad to assist in the negotiation of the terms of such a concession. Members of the American diplomatic corps having business experience, the general consular officers or the consular economists or commercial attachés, could be used for this purpose. Some of these officers can act as interpreters, advise as to reliable local attorneys, suggest means of avoiding or overcoming difficulties, advance plans for breaking deadlocks in the negotiation, etc. I do not say that American representatives will do this, but they can do so, on instructions of the department, with entire propriety without infringing any of several restrictions mentioned above. They already have had general instructions as to the vital relation of oil supplies to the national interest and have standing instructions to support bona fide American-controlled companies.

### Companies Must be Honest and American

If the negotiations do not succeed, say because a French company is overbidding the American company, the department, when the American company is unable to meet or better the French terms, may volunteer to assist the foreign government concerned to obtain something which it needs in the United States, such as financial assistance, the use of ship yards, etc. If this is of no avail and there has been equal opportunity, there is little more that the Secretary of State

[1] Petroleum Legislation and International Regulations, *Min. & Met.* (May, 1921).

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can do. He cannot use the "big stick" to force the hand of the recalcitrant country by a naval demonstration, although he can show the displeasure of the United States against the use of such tactics by another country, which is not to be lightly disregarded in these times; nor can he continue to support the efforts of the American company if at this stage it resorts to questionable practices to obtain the concessions.

Perhaps at this point in the negotiations, when the difficulties that beset the development of oil fields in alien lands are becoming manifest, it occurs to the president of the company that it would be a good thing, before going further into this business, to ascertain how far he may rely on the protection of the United States Government in case of trouble, and he propounds this question to the Secretary of State. The department's files are full of such questions and the secretary's answer, naturally, will not be new. It will be courteous and apparently sympathetic, though it may not commit the department to any definite course of action, or frankly promise the support desired. It is aimed to meet any contingency. In my opinion, however, there is not the slightest reason why the department should not answer the inquiry frankly and without hesitation to the effect that the United States Government will give the company every possible assistance and protection in the future against unwarranted encroachments on its rights and privileges.

If, with this assurance or otherwise, the negotiations proceed and a concession is signed between representatives of the foreign government and the American company, it may have to be submitted to the legislature of the country for approval, unless the executive has full authority to conclude the contract. Should opposition to the concession develop in the legislature, there is little that the Secretary of State or the American representatives in that country can do. They cannot with propriety actively lobby for the measure and, of course, they must withdraw their support if questionable practices are resorted to by representatives of the company.

When the concession is approved according to the constitutional system and legal forms of the country and the exploration and exploitation is under way, many difficulties may cause the foreign government or the company to fail in carrying out the stipulations of the contract. Then the company may appeal to the Secretary of State for assistance to prevent the possible cancellation of the concession, interminable litigation in alien courts, loss of the investment, or other contingency. The secretary foresaw this when he gave the cautious assurance about assistance and protection and you may find that under it he is entirely free to take action or no action as may seem to him expedient. The liberty to protect or not to protect is the main weapon of the department; with it the details of the whole case from the beginning may be brought to the light, minutely inspected and subjected to searching catechism. This is a very necessary precaution in some cases, not only to determine the bearing of the limitations on the department's support, but to prevent the department from being imposed on in various ways. Pending this examination, however, the secretary may telegraph the American Minister or Ambassador at the capital of the foreign country in question, to ask a temporary stay of proceedings until the department has had opportunity to examine the case. Generally this is helpful, but sometimes the proceedings cannot be postponed or the "face" of the foreign government will not brook such interference. In the meantime, the department is examining the details of the case to see what assistance can be rendered in the circumstances. Obviously, in this task, it needs the vision, experience and force of the trained business man. Under the present procedure, if the good faith of the company is apparent, if malpractices on its part are absent, if its nationality is unimpaired, if there is no recourse to the courts available, if the international relations of the two countries are propitious, if there is no other opposing reason, undoubtedly the department will send a strong note to the offending country. The case then becomes one between the two governments concerned and the discussion may possibly drift into a protracted diplomatic correspondence and an international controversy only to be settled by arbitration.

For obvious reasons, this procedure is unsatisfactory and I am frank to say that, if possible, the Department of State, by every means in its power, in coöperation with the company, should endeavor to prevent the matter from taking this course. Sometimes this may be done by promptly bringing the company and the foreign government together in direct negotiations under the good offices and influence of the American Minister accredited to that government, with a view to reaching an amicable settlement on satisfactory terms. This method of prompt, energetic assistance by the Secretary of State during the early symptoms of the trouble, and before antagonisms crystallize into bitterness, is in the ordinary case quite within the limitations of the Department of State and the properties of diplomatic intercourse.

There are many other ways in which the Department of State can be helpful to American oil men abroad of which space forbids mention. If the Secretary of State, through the agency of the Pan-American Union in Washington or otherwise, should call a petroleum conference of the American republics, including Canada, to discuss the rigorous limitations in area, ownership, profits, etc., set by the laws of many Latin-American countries to the exploitation of their petroleum resources, as well as the advisability of imposing only such restrictions as are necessary to protect the interests of the American nations and invite capital and enterprise to undertake development, and the advantages of enacting uniform laws much that would be of mutual benefit might be accomplished.

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# Revision of the Mining Law

By F. R. INGALSBE,
Geological engineer, Missoula, Mont.

THE proposed revision of the mining law as set forth in the Arentz Bill, now before Congress, is centered about the pretty commonly acknowledged fact that the present law is outlawed both by the large mining companies and the United States Land Office. By common agreement, the law of the apex is non-operative as between adjacent properties in many instances, and this practice is becoming more common. If this is a fact, there is no escape from the conclusion that the law is antiquated and should be revised to meet modern conditions more equitably. The thing to be considered seriously is in what direction and to what extent the laws should be changed. Before deciding this, it is logical to inquire in what particulars the present law is troublesome or useless. This was all threshed out by the committee of the Bureau of Mines that worked out the proposed bill, but their testimony was not placed before the public, so far as I am aware.

Most mine managers and engineers connected with producing properties are a unit in agreeing that the law as applied to the underground extension of orebodies, that is, the "law of the apex," as it is called, is the source of more litigation and expense than any other phase of the law, or perhaps than all other phases combined. This being true, it seems that this part of the law should be changed. Another phase which is troublesome and will continue to be so long as there is unpatented mineral land on the Public Domain, is the discovery requirement. The present law requires that a discovery be made before a claim is staked and the courts certainly agree that such must be the case before patent issues.

## Better Definitions of Terms Needed

Of course the definition of "discovery" is subject to various interpretations by different courts, even though its definition is set forth in clear language. The trouble comes in its application to various localities and circumstances. What is a discovery in the heart of a producing district may not be a discovery in anout-of-the-way place, and even in mining camps there are often differences of opinion. It would seem that the rule of common sense should apply in such cases, but the common sense of the claim owner and his neighbor might not agree, and very often do not. Even the owner, himself, may not have a very high regard for his discovery, yet so long as there seems to be a chance to sell out to his neighbor at a profit, he will perform assessment work sufficient to hold his claims. Such locators are the parasites of the industry and the trouble makers of the camp. They are in the minority, but as real discoveries become more difficult to make they become more troublesome, for they must live somehow. They take advantage of this uncertainty based on discovery interpretation of the law. This feature of the law should be less subject to various interpretation.

## Honest Assessment Work Requires Capital

This brings up the assessment requirement of the law. It is pretty generally admitted by those in a position to know from experience that in many, if not in the majority of outlying districts, the assessment work is not honestly done. There are two reasons for this: first, and probably most important, is the cost involved. Many prospectors have more locations than they can conveniently carry but they do not care to abandon any of them. Secondly, it is claimed that most of the surface work done after a discovery has been made is wasted money and energy, because it adds no permanent value to the ground. The development of a group of claims requires machinery for expeditious and economical work, and therefore is beyond the means of most prospectors. Prospecting work is admittedly valuable when done systematically, even though the results are negative. If ore is found, the location and course of the orebody are determined in a measure and if none is found the ground will not have to be explored again. Certainly systematic prospecting is valuable if careful records are kept of the results.

It is freely admitted that a way to avoid the difficulties connected with assessment work will not be easy to find. Most certainly no way will be found that will meet the approval of all claim owners. I can think of only two methods of disposal of mineral lands on the Public Domain that might do away with this feature entirely. The one that would relieve the Government of all difficulty is the outright sale of mineral lands to the highest bidder; the other is the leasing system practiced in many Latin American countries. The sale outright to the highest bidder is contrary to the spirit of our public-land laws and the latter is so objectionable to the mining industry as now

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constituted that it would stand no chance of becoming law. I am sure that neither the prospector nor the mine owner would like to see our mineral lands sold at auction and I am equally sure that the mine owner prefers a title in fee, even though he must pay a high price for it, rather than payment to the Government of a royalty on every ton of ore removed from the mine.

The purpose of the land laws to encourage individual initiative by making it possible to reap considerable rewards is undoubtedly the better system, even though it is becoming more difficult as time goes on to make valuable discoveries. The burden of finding new mineral resources is falling more and more on those who have made money in mining, and this is as it should be. The industry should and must eventually support itself.

### Purpose and Manner of Revision

In his article on Revision of the Mining Law, on page 4 of Mining and Metallurgy of April, 1922, P. E. Barbour has set forth in a very able and, it seems to me, convincing manner the purpose and manner of revision as exemplified in the Arentz Bill. The law of the apex is done away with quite skillfully while retaining most of the court decisions handed down in the past. The Bill seems to strike a middle course and is probably the only kind of a bill that has any chance whatever of getting through Congress. Ten-acre claims with vertical boundaries are made the unit of location and these should be laid out in cardinal directions, but as Mr. Barbour says, the cardinal direction feature is not a vital matter. Let prospector Bill or the Prosperity Mining Co. stake out their locations in any desired direction, just as they have been accustomed to do in years past. This would complicate the situation somewhat but it would not defeat the purpose of the bill which is to do away with the apex feature of the present law. The bill attempts to remedy other minor features also, but the apex phase is probably the most vital change.

In doing this, the committee is taking advantage of what is practically a world-wide experience, so it is not a new idea. In fact, the United States is the only country, so far as I know, that universally clings to this kind of law. The experience of the eastern part of the United States and the majority of countries that support an important mining industry favors the vertical boundary idea because it leaves less uncertainty hanging over the title to orebodies than any plan ever devised which carries with it the fee title.

There is undoubtedly a small class of professional men in the country, both lawyers and consulting engineers, who are not anxious to see any changes made in the mining laws, but they have a more or less selfish purpose in mind. They are the people who make large fees out of mining litigation. They make fine sounding arguments against revision on the ground that it will do away with present rights, it will disturb present customs, and anyway, it is too late in the day to change. Such arguments are arguments only, as a little consideration will show.

The proposed change will not do away with existing mineral rights; to be sure, it is late in the day to correct our mistakes, but it is not too late. I presume this country will have an important mining industry for several years to come. In fact, mining is still a young business which must expand enormously in the future to take care of our demand for the metals, and I have found no one who thinks that such will not be the case. We must look to the future of the industry, having in mind its welfare through the years to come rather than the interests of a few individuals for the day.

Mining conditions are changing rapidly and it is to meet these that the proposed revision was formulated. In a sense, the Arentz Bill is progressive legislation but it retains enough of the past to assure us that it is not radical. It is based on the experience of most of the world for centuries and is the outgrowth of a real demand. It seems to open no more opportunities for public-land swindles or graft than the present law. Summed up in a few words, its purpose is the reduction of cost and trouble to legitimate mining enterprises, and if it can do this even in a small measure, it is worthy of support.

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## Mercury Poisoning

THERE is probably no industry, trade, or art in which mercury is used that has not produced some cases of mercury poisoning. Dr. R. R. Sayers, chief surgeon of the U. S. Bureau of Mines, in Serial No. 2354, gives information regarding measures recommended for the prevention of mercurial poisoning and details regarding its treatment.

The frequency and severity of cases of mercury poisoning are fewer with modern methods of mining and recovery of the metal than formerly, but further reduction is possible.

Insufficient or improper ventilation of the working places, together with failure to maintain sufficient back pressure to prevent the escape of mercury vapor from furnaces, condensers, and retorts, is a very important predisposing cause of the poisoning. Uncleanliness of the workmen appears to be no small factor in the production of the condition. Men who do not wash their hands well before eating, who do not care for their teeth, and who fail to rinse the mouth well before eating and drinking, those who do not take a hot cleansing bath at the end of each day's work and who do not change their work clothing for street clothing after work, develop mercury poisoning more often than those taking these precautions.

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# Mining Methods

By C. F. JACKSON

Secretary of the Mining Methods Committee, A. I. M. E.

THE work of the Mining Methods Committee is now well under way. Following discussions previous to and during the February meeting, an Outline for Papers on Mining Methods was prepared, and over a thousand copies have now been distributed to committee men, to section secretaries and to members who have indicated any interest in the subject.

The objective of the committee is to prepare a symposium on mining methods which will be of real practical value to the operator and engineer in the solution of every-day mining problems. It is planned to cover the entire field of mining in such a way that the different branches of mining, such as coal and ore (iron, copper, lead, zinc and precious metal) can benefit from the experience of the others at points where they have problems in common. It is realized fully that each of these branches of mining possesses its own peculiar problems, but at the same time, there are problems in connection with each, where the experience in others should be of value. The committee proposes to proceed along the following lines:

1. To present a general classification of mining methods, showing their inter-relationship, and at the same time provide a common language for the discussion of mining methods and a nomenclature that will have the same meaning wherever used. A complete set of illustrations will accompany the classification to make clear the terminology adopted and to show graphically the inter-relationship of methods.

2. To show the relationship between the physical characteristic of the deposit, the economic considerations and the mining method. It is not proposed to treat this subject as a mere academic problem, but to secure reports from every mining company of importance in this country, which will show what methods or modifications and combinations of methods have actually been applied and the physical conditions and economic considerations which have led to the adoption of these methods in each case. The Mining Methods Committee has drawn up an Outline for Papers on Mining Methods to be distributed among mining engineers and operators, giving in detail the information desired. This outline is the result of several months of careful thought and is a composite of the suggestions of many engineers and mining company officials from all parts of the United States.

3. From the reports submitted, which are to include detailed unit production data (not costs), it is hoped to present on a comparable basis as between methods, the economic results obtained by different methods applied to mineral deposits of similar physical character as regards size, dip, grade and distribution of values, strength of orebody, enclosing rocks, etc. The comparison will be on both the basis of unit production and per cent. extraction of ore and valuable mineral. The reports should also show the evolution of the finally adopted methods from the methods first tried in each case and the comparative results obtained by the initial and finally adopted methods.

4. A large number of the more prominent mining companies have agreed to prepare the data suggested in the outline, believing that the interchange of such data will be mutually beneficial. The committee realizes that many companies can furnish the data only at the expense of considerable detailed clerical work, but it is believed that the preparation of the data will be of inestimable value to the officials of the companies in the analysis and regulation of their operations, and also will be of value to the employees working up the data, in giving them a better insight into the operations and thus increasing their value to the company and to themselves.

The committee recognizes the worth of the many able and valuable papers on the subject of mining methods which have appeared in the technical press over a period of some years and hopes to make use of these with due recognition of the authors. The next step, which is the work contemplated by the committee, is to tie these up with the additional data to be obtained through the mining companies, in such a way as to be of practical use to the engineer faced with the problem of adopting a new, or improving his present, mining method.

5. Special committees have been appointed to cover the various branches of mining, as follows: Advisory Committee, Classification Committee, Anthracite Coal Committee, Bituminous Coal Committee, Copper Committee (further divided into Southwestern, Butte or Northwestern, and Lake Superior Copper), Iron Committee, Lead and Zinc Committee, Precious and Rare Metals Committee, Non-metallic Ores Committee, and Sampling and Estimating Committee.

This division of the work is one of convenience, associating on a given committee men engaged in the production of the same product or mineral. It

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is realized that fundamentally the mining method depends on the physical characteristic of the deposit and the grade of ore and distribution of values, irrespective of the mineral or metal to be won.

Papers have been solicited from members particularly familiar with certain deposits, but the committee is desirous of supplementing the work of the special committees by securing data from as many sources as possible, and members who are interested are invited to submit papers covering operations with which they are particularly acquainted, though they have not been personally solicited.

Such papers should be sent to the general secretary, C. F. Jackson, 407 Perry-Payne Building, Cleveland, Ohio, who will forward them to the proper sub-committee.

## Revised Chart of Mining Methods

- **Open Cut, with or without Stripping**
  - Benches
  - Glory Holes and Milling
  - Placer Mining
    - Hand Sluicing
    - Dredging
    - Hydraulicking
- **Underground Methods**
  - *Breast Stoping* (Tabular, flat-dipping deposits or beds)
    - Continuous Horizon
    - Casual Pillars
    - Room-and-Pillar
  - *Underhand Stoping* (Veins and large masses)
    - Glory Hole and Milling
    - Open Stope
      - With Pillars
      - With Stulls
      - With Square-set Timbering
  - *Overhand Stoping* (Steep-dipping veins or masses)
    - Open Stope
      - With Pillars
      - With Stulls
      - With Square-set Timbering
    - Filled Stope
      - Horizontal Cut and Fill (Flat-back)
      - Inclined Cut and Fill (Rill)
      - Square-set Timbering
      - Resuing or Stripping
    - Shrinkage Stope
    - Sublevel Stopes
  - *Top Slicing* (Wide veins or masses)
    - Continuous Horizon
    - Panel Slicing
    - Block Slicing
    - Inclined Slicing
  - *Caving* (Large masses)
    - Sublevel Caving
    - Block Caving
      - Undercut from Main Level
      - Undercut from Sublevels
      - Back Caving into Chutes
      - With Branch Raises
  - *Combined Methods* (Large masses)
    - Alternate Shrinkage Stope and Pillar
      - Pillars Mined by: Top Slicing, Sublevel Caving or Block Caving
    - Square-set Timbering: Pillars Mined by Slicing

This chart, compiled by the special Committee on Classification of Mining Methods for use with the Outline for Papers on Mining Methods supersedes the one published in the February number of Mining and Metallurgy.

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# Federated American Engineering Societies

THE Executive Board of The American Engineering Council met in Pittsburgh, May 26 and 27. Its actions on the licensing of engineers and on the Employment Bureau are printed at length elsewhere in this issue.

The board announced plans purposing the solution of the national problems of water power and forestry, upon which "the industrial development of the nation and the standard of living of future generations largely depends." The whole Federal water-power situation is in so critical a condition that immediate constructive action by the Government to conserve the public interests, involving vast consequences of economic and Federal policy, is necessary. After a long discussion during which the water-power problem as it affects Government reorganization was reviewed and Henry Ford's Muscle Shoals plan was discussed, the board decided to lay the entire question before President Harding.

A national movement to conserve the nation's forests, in which engineers, the U. S. Forestry Service, the forestry services of the states, universities and technical schools, and other groups such as the farmers, the railroads, and lumbermen, shall pool their efforts, was set in motion by the engineers. The work will be in charge of a Reforestation Committee of the Council, headed by Charles H. MacDowell of Chicago. Moving picture interests will be asked to aid.

The board pledged its support to President Harding in his plan for Government reorganization.

In adopting the report of its Committee on Public Affairs, headed by J. Parke Channing of New York, the Executive Board of the Council determined, in the event of the failure of the President's efforts to bring about greater economy and ffieciency in national affairs by regrouping of Federal functions, to press independently a nation-wide movement for the establishment of a Department of Public Works.

Progress in a national survey of the two-shift day in American industries was reported by the Council's Committee on Work Periods in Continuous Industries. This survey, called the most extensive of its kind ever made, has been in progress for more than a year, and purposes an exposition of industrial conditions which shall form a basis for establishing the relative merits of three shifts of eight hours each and two shifts of twelve hours each.

The national problem of flood control was described as of vital importance, and it was decided to coöperate with other agencies in finding a solution, involving the establishment of a national hydraulic laboratory.

The board voted continued coöperation with the numerous organizations interested in types of Government contracts. A study was directed of a proposed form of universal contract agreement as applied to railroad construction and drafted by a joint conference on standard construction contracts.

Committees are at work on a general policy of affiliation of American engineers with the engineering bodies of other nations. It was said at the meeting that a movement is on foot, which is being led in London by Sir Robert Hadfield, to form an Anglo-Saxon union of engineers to include the English-speaking peoples of all countries, which resulted from the close coöperation of British and American engineers during the war.

Successful accomplishments of the study of business cycles conducted by the Council with the assistance of 150 engineering groups and in coöperation with the Department of Commerce was reported. The data gathered are now being compiled in Washington and will be available to further the plans of the President's Committee on unemployment in its study of cyclical depressions.

Reforestation, jurisdictional awards in labor, patent legislation, an International Engineering Congress, aerial research, engineering representation on the Civil Service Commission, foreign relations, waste in agriculture and plans for more intensive engineering organization as proposed by Herbert Hoover, were other topics before the Council, which contemplates closer and more active coöperation with the Federal Government in public questions involving engineering experience.

In a report to the board on the work of the National Board for Jurisdictional Awards, in response to an order for an inquiry by the Council, Secretary Wallace said:

"The building industry has been in strong disrepute with the American public ever since the war. If there were no jurisdictional board it would be more so, and remain so until, among other things, a jurisdictional board or similar agency was created. The Jurisdictional Board is one of the fundamental bases upon which the rehabilitated building industry for the future must rest."

A report from the Patents Committee of the Council, headed by Edwin J. Prindle of New York, voiced

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opposition to the Stanley and Ladd bills as detrimental to American invention and industry.

The board, after declaring its readiness to serve in the public interest wherever engineering experience is involved, adjourned to meet in Boston in the fall on a date to be fixed by the Committee on Procedure.

## Federated Decides that Mining Engineers Should not be Licensed

ONE of the most important acts of the Executive Board of the Federated American Engineering Societies at its meeting in Pittsburgh, May 26 and 27, was the adoption of the report of its Committee on Registration of Engineers, of which Col. Arthur S. Dwight, of New York, is chairman and the other members are Philip N. Moore, of St. Louis, Mo., and Gardner F. Williams, of Ann Arbor, Mich. The report as adopted contains the statement "that the reasons which justify the registration of engineers responsible for public work do not apply to mining engineers," and continues:

"In considering matters of government as affecting the engineering profession of the United States, the ancient principle that "that country is governed best which is governed least" has been accepted by your committee as representing ideal conditions, and it holds that in an ideal social organization, where man can be left free to follow the trend of his individual bent without resulting injury to his fellow, each should be free to follow such calling as he may adopt, without state interference or regulation.

"Engineering in the United States, under absolutely untrammeled conditions in the past, has developed effective skill and a high degree of constructive ability among its practitioners, during which period the provisions for safety have been adequate under average conditions, and the failures which may have occurred have not been rated serious enough to demand legal control.

"Within the past few years, however a, widely supported movement appeared, resulting in the passage of laws requiring licensing or registration of engineers in various states, and attempts at similar legislation in others.

"It is, therefore, a condition and not a theory which is before the engineering profession for consideration, and the F. A. E. S. should decide whether it will lend the weight of its advice upon principle only or will accept and travel with tendencies.

"The registration or licensing of engineers with consequent elimination from practice of all not registered, can be supported on only two grounds: (*a*) the benefit of the profession; (*b*) the good of the public.

"Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it would be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of a statute.

"Your committee, while recognizing that required registration might not have been recommended *ab initio*, believes that the plan has now reached such development as to deserve consideration and possible direction by the F. A. E. S. (or A. E. C.) Therefore:

"Your committee recommends to the A. E. C. (F. A. E. S.) an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works.

"Your committee is agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers.

"Your committee is unable to agree as to the wisdom or unwisdom of registration of engineers engaged in other classes of work.

"Registration laws should provide reciprocity of registration admitting to practice engineers registered in other states and should further provide for the admission to practice of properly accredited engineers from states having no registration laws.

"Registration laws should provide for classified registration, that the certificate may indicate those branches of engineering in which the registrant is qualified to practice."

## Engineering Societies Employment Service

WHEN the Federated American Engineering Societies was formed, the Employment Bureau, which was being operated at 29 W. 39th St., New York, by the secretaries of the four national engineering societies, became part of the Federated activities and was financed and operated by them, with opportunities for participation offered to all constituent societies, but the immediate direction remained in the hands of the four secretaries.

Employment service committees of the Federated have from time to time discussed various schemes for a national service bureau, collecting fees of registrants from all successful applicants, or from employers served, but no satisfactory working plan has been evolved.

Some of the smaller engineering clubs in more or less distant states have felt that they were getting no benefit from the Employment Bureau under the Federated operation and objected to their funds going to its support, so that at a meeting of the Executive Board of the Federated in Pittsburgh, May 26 and 27, it was voted to return the Employment Service to the four national societies.

The following report of the chairman of the Committee is quoted from the minutes of the meeting of the Executive Board.

This brief report is submitted for the purpose of inviting discussion and that the board may get the viewpoint of the committee.

Your committee recognizes the importance of the task committed to it and desires as early as possible to submit its final report.

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The committee feels that if the Federated American Engineering Societies is to take advantage of an opportunity in line with the purpose for which it was created, the solution of th employment problem is one of the greatest activities ite can undertake.

Employment Service is the rendering of an individual service to members of the profession and to industry in general, and no one branch of the profession can render as effective and efficient service as a national bureau since—

To serve industry as a whole, there should be maintained a contact with all branches of industry and all branches of the engineering profession.

Your committee proposes to continue the study of the problem on the basis of service to the nation, to industry and to the engineer, and recommends that the existing employment service be continued for the time being.

It proposes to investigate the possibility of establishing the employment service of national scope, with local branches independent of the activities of national, state, regional or local societies, but so interlocked by representation with such organizations as to make them an integral part of the plan.

It is proposed to make the service self-sustaining.

It is proposed to have this service so established that member societies of the Federated American Engineering Societies or any other societies interested may, if they so desire, maintain a reference bureau in connection with their own activities so as to render a special service to their individual members.

The committee invites written discussion from those interested.

This report precipitated a lengthy discussion, and this discussion led to the introduction of a resolution, which, after being amended in several particulars, was passed in the following form:

VOTED: WHEREAS, The experience of the American Engineering Council of the Federated American Engineering Societies with the Employment Service previously conducted by the four national engineering societies, designated as Founder Societies, has demonstrated:

1. That such employment service is essentially a local and personal service.

2. That the benefits of such service have almost exclusively accrued to those members of the engineering profession resident in the vicinity of the headquarters of the service.

3. That a census of the membership of the said four national societies indicates that only about 20 per cent. are so resident, and that approximately 80 per cent. of the cost of such service is a burden upon that portion of the membership which by no possible chance can receive any benefit therefrom.

4. That the maintenance of the said Employment Bureau has in no wise facilitated the work or diminished the burdens of the Employment Services maintained by the local societies associated in this organization.

5. That the cost of maintaining the said Employment Bureau is far in excess of any contribution the individual beneficiaries make to the finances of the American Engineering Council.

BE IT THEREFORE RESOLVED: That the said employment service be returned to the jurisdiction of the secretaries of the four Founder Societies, and

BE IT FURTHER RESOLVED: That the existing Employment Committee be continued to study and report upon the possibilities of a paid nation-wide employment service for all engineers.

VOTED: That the Employment Committee continue its study of the national employment service, inviting other interested professional groups to coöperate in the investigation.

VOTED: That in view of the action taken, the Finance Committee be given power to make a proper rebate of dues to member societies.

VOTED: That the Employment Service be returned to the Founder Societies on July 1, 1922.

## Hints on Job-getting

BY THE ENGINEERING SOCIETIES EMPLOYMENT SERVICE

THE experience gained by interviewing hundreds of employers and thousands of employees seems to prove that the average unemployed engineer of today passes through three stages before making a new connection.

The first may be likened to that of a chicken which has recently been deprived of its head. First comes the severing blow of discharge quickly followed by a wild outpouring of hastily prepared and ineffective letters, fit only for the waste basket; and a mad aimless rushing hither and thither after jobs for which he is totally unfitted. Should anyone dare to offer the kindly suggestion that he is reaching for something beyond his grasp, the would-be applicant sees a diabolical attempt to keep him out of work and bull-headedly insists on having his way; blindly ignoring the fact that he is wasting his time.

Meeting with no success, he is overcome by an enervating feeling of self-pity, and proceeds to give a most excellent imitation of Sir Isaac Newton discovering the law of gravity. While the achievements of great scientists are always worthy of imitation by engineers, there is very little chance these days of a pretty little cotton-wrapped job gently falling into the lap of any man. At this stage he spends a goodly part of his time in composing bitter arraignments of things in general and is quite firmly convinced that the hand of both God and man is turned against him.

Finally, he reaches the third stage, where he decides to quit imitating the ostrich, withdraws his head from the sand of ignorance and personal prejudice and faces the cold hard facts in the light of day. Now something can be done to help him.

To get a job one must sell one's services. Unfortunately, the prospect of having to go out and attempt a sale seems to throw most engineers into a blind unreasoning panic. This is due, doubtless, to a childlike acceptance of that most fallacious and weak-minded, though generally accepted, statement that an engineer cannot make a good salesman. And why not, pray? Surely a man who understands human nature, knows his goods, thoroughly believes in them, and displays a reasonable amount of enthusiasm in presenting them, should stand a good chance of making a sale. The trouble with the unemployed engineer is that he does not know his goods, consequently has no strong belief in them and instead of presenting them with a show of sincere enthusiasm, tries to cover these defects with a bluff; thus inevitably appearing either as a "know it all" or a charity seeker.

When an employer desires a man to fill a specific opening, he usually has a more or less well defined idea of the kind of man he wants, and that applicant is successful who most closely approximates that ideal. True it is that one occasionally meets a man who does not seem to know what he wants—and this is really the easiest type of man to deal with, providing the applicant knows and believes in himself. The employer's nebulous ideas often can be crystallized into a form according almost exactly with the qualifications of the applicant. Unfortunately, most applicants seek merely a certain salary and are ready to take almost any kind of a job that will pay it, hence to a prospective

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employer they appear weak, doubtful of their own capabilities and create a negative impression. When a man is hired a contract is made, and a contract has been well defined as "a meeting of two or more minds." How, then, can two minds meet when only one of them has a well defined set of ideas?

The first thing for a man to do is to draw up a detailed list of his qualifications, personal, educational, practical. Let him play fair with himself and note both strong and weak points, for here is a chance to make progress; ambition will force every normal man to seek remedies as soon as he recognizes his weaknesses. Next, he should whip this detailed list of qualifications into a clear, concise, forceful experience record which will show him up in the best light possible. This is the hardest part of the whole task and will require not an hour, only, but more often days of hard, consistent, even painful, effort. When properly carried out, it creates a wonderful feeling of confidence, and gives him a sharply defined idea of his size pertaining to any job he goes after. As a result, he no longer wastes his time and efforts in madly chasing after a wild series of impossible jobs, but settles down to a very determined and much more frequently successful hunt for a job within his capabilities. Incidentally this is an ideal time to take some thought of the future and decide what one would like to be 10 or 20 years from now, thus gaining an idea of how far one has progressed along the desired path, and what steps must still be taken to attain the goal. One should set up a high standard, but not an impossible one; and what that may be each man must determine for himself. This mode of procedure enables a man to make a progressive effort to gain a job which is within reason and which will enable him to gain additional valuable experience.

Logically, the next step is to find a market for the goods. This is where the Employment Bureau, advertisements, letters and personal tips should be used, but bear in mind that these are media only and none of them will or can get the job itself, they merely put one in touch with it. Most jobs, and particularly the good ones, are "By Letter," so it behooves the applicant to give heed to what constitutes a successful letter. To begin with, avoid wasting a paragraph or even a sentence telling how the job was located; the heading does that. Set forth the qualification in general but forceful terms; the experience record will give the details and proof. Above all, be concise, for if you really know—don't think or hope—you will fill the job, your letter will show it.

When seeking a particularly desirable job, it is excellent practice to analyze each item of the general experience record and consider its exact bearing on the job in question, then, by rewriting the record, one is in a position to give to each phase of the experience its proper relative degree of prominence, thus creating a much more favorable impression than would be the case were the general record offered.

Finally, comes the interview. Its success will be dependent on the personal impression, intelligent expression of requirements and qualifications, and mutually satisfactory terms. Physical appearance counts for a great deal: some are naturally gifted, others are not, but one's natural inclinations usually incline one towards a line with which the physical appearance accords. One does not pick a dray horse for the racetrack. So look to the neatness of clothes, face and shoes; and let the guest beware of his manners. Watch carefully the questions and answers, for the tongue has often slipped many a man out of a good job. And lastly, endeavor to be reasonable in one's demands.

The following summary supplements the foregoing remarks. It is hoped that both will cause the man who is looking for a job to *think well*, before he acts, and to remember he must *act intelligently*.

### Summary of Hints

1. Decide on what you want.
2. Make sure your qualifications give you an even chance of getting it, but don't think 100 per cent. is necessary. Perfection does not exist.
3. Don't go after a job unless you mean business.
4. There are three factors to every job, *viz.*, advancement, experience, salary. Don't ignore the first two.
5. Remember that the *job* gets the salary, not the applicant's qualifications.
6. Job-getting is selling one's services. The successful salesman knows his product thoroughly. Study your goods.

#### *Letter-writing*

1. The object of a letter is to get an interview. Letters don't get jobs.
2. Padding of payrolls is a felony. Padding of letters is equally dangerous for the job-hunter.
3. A letter must: Arouse interest; create desire; prove the case; convince the reader that an interview will be profitable. Hence: Be as brief as is consistent to prove your claims; make no claims not backed by the experience record; always include the experience record.
4. Attractive packages improve the sale of goods. Therefore typewritten letters on plain business stationary are better than longhand ones on club or personal stationary.

#### *Interviews*

The interview is "the day in court." Getting it is only half the battle. When being interviewed:

1. Be fully confident of your worth, but not presumptuous.
2. Be sure you want the job and be ready to prove why you should get it.
3. Ask a fair market price for your goods. Don't profiteer. Don't be a philanthropist.
4. Assay the three elements—advancement, training, salary—and be guided by the sum of the three in accepting or declining.
5. Leave in a pleasant, hopeful manner if the job is not decided then and there.
6. A letter of acknowledgment of the courtesy of an interview is good policy following a promising call.

#### *Finally*

Maintain the proper mental attitude. Don't let your morale slump. Nobody wants a grouch or a man who is not sure of himself.

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# Abstracts of Institute Papers

The following papers will be printed in full in pamphlet form.
A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 22 of the Advertising Section. Discussion of papers is invited.

## Factors Controlling the Capacity of Rock Crushers*

By Ernest A. Hersam, Berkeley, Cal.

THE rate of output of a rock crusher is based upon a certain space relation, the calculation requiring that the size and position of the jaws, the principle of motion, and the speed of the machine be known. The result is a calculated maximum output. The purpose of this paper is to develop a method of calculating this maximum output, to judge the general applicability of utility of such a calculation, and, so far as possible, to record calculated values as a basis for the comparison of actual results, or for estimating the capacity of a new crusher or of a standard crusher working under new conditions.

A method for calculating the capacity of crushing rolls, which has been in common use for a long time, is well presented by R. H. Richards. The output is conceived as a ribbon of rock, of which the breadth, thickness and length are governed respectively by the width of the rolls, the space between them, and their peripheral velocity. The weight of the rock thus crushed in a given time can be calculated from its specific gravity, after applying a factor representing the percentage of voids in the hypothetical ribbon.

The calculation of crusher capacity is made in a somewhat similar manner. While the action of rolls is simple, with few irregularities in operating conditions, in rock crushers the material advances intermittently, usually under the force of gravity alone, and subjected to a variety of variable conditions. The effect of these variable influences on the calculation of capacity is shown. In this paper, capacity is discussed quite apart from any consideration of mechanical efficiency; that is, results will be stated not in terms of output per horsepower, but of output for a given machine when operated at a known speed, constructed and adjusted to receive material of a known size, and to yield a product having a definite maximum coarseness.

In the practical operation of a crusher, it is obvious that certain mechanical irregularities may cause deviations from theoretical values. The causes of these discrepancies may be grouped as follows:

1. Shattering.—A necessary increase above the calculated capacity results from the shattering and disentanglement of the rock during the approach of the jaws upon it.

2. Resistance.—The theoretical output is diminished when the rock fails to drop stably into the displacement space as the jaw of the machine opens.

3. Speed.—The theoretical capacity is diminished when a machine is run at so high a speed that the rock is unable to fall the entire distance to be traversed at each cycle.

4. Slipping.—The theoretical capacity of a crusher will be diminished by the slipping and upward displacement of the rock as the jaws advance upon it.

5. Interference.—The theoretical capacity is diminished by the fact that the rock, even under compression between the closed jaws of the machine, will not occupy the full displacement volume; voids are always present.

Then follows a development of formulas and a discussion of the constant and variable factors. The following crushers were tested: Dodge, Sturtevant, McCully, Comet, McCulley No. 5, Hercules-Blake.

From this investigation the conclusion is that when estimating the capacity of crushers under given conditions, it is necessary to employ an empirical factor which has been designated by the letter $k$, representing the percentage ratio between actual crushing rate, and a theoretical capacity based on the dimensions and other correlated data. The accuracy of this factor limits the precision of the estimate. The actual value of $k$ is a resultant of numerous contributing influences. The tests were designed to study the effect of each dominant influence by itself, and to approximate a correct value for the factor under known conditions. Under ordinary operating conditions, $k$ will rarely exceed 75 per cent.; for particular conditions, a somewhat more accurate value can be deduced from the data referring to the individual tests.

* San Francisco Meeting, September, 1922.

## Basic Principles of Gravity Concentration—A Mathematical Study*

By Theodore Simons, Butte, Mont.

THE rapid and comparatively recent development of flotation has opened so fascinating a field for study and research that the older processes of gravity concentration no longer receive the attention that they deserve.

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The early work of Munroe and Richards, and the more recent contributions by Clevenger and Coe, Laist and Wiggin, Ammon, Bardwell, Crowfoot, and Hayden, to mention only some which have appeared in our own TRANSACTIONS, and by Schulz, have furnished such a wealth of data that an attempt to offer something new seems a difficult task. It is still possible, however, to present known facts from a different point of view, and, with this in mind, the writer has undertaken to express basic principles of gravity concentration in terms of simple mathematics and mechanics. The conclusions thus reached will be found to correspond, in general, with those obtained by experimental methods.

Rittinger, in his classic *Aufbereitungskunde* (1867), reached analogous conclusions by way of intricate higher mathematics, for which reason his interesting investigations have remained a sealed book to most of us. The writer hopes that a more elementary treatment of the subject, based in part on Rittinger's methods, may arouse new interest in the study of basic principles.

The most widely employed processes of gravity concentration depend on the behavior of mineral particles in water (dry processes also have their place) and take advantage of the difference in the speed with which minerals of varying size and density fall in still or moving water; or of the difference in the resistance that they offer to a current of water flowing down an incline.

If a mixture of mineral particles of various sizes and densities is allowed to fall through water from a given height, all starting at the same instant, the individual particles of the mixture will form layers, according to well defined laws. The bottom layer will contain coarse particles of the densest minerals, but only the largest particles of the less dense ones; while the uppermost layer will contain the smallest particles of the densest minerals, side by side with both coarse and fine particles of the less dense ones. The particles found in any particular layer will be of different sizes and densities, but will have a nearly "equal-falling" velocity in water; that is, they traversed equal distances during the same time interval.

A study of "equal-falling" mineral particles of uniform shape shows that their volumes and densities are interdependent. In vacuo, all bodies are "equal-falling," irrespective of size, density, or shape. Falling through a fluid, whether air, water, or other liquid, they meet a resistance, the most perceptible effect of which is a decrease of acceleration; if falling in water, acceleration disappears very quickly, and a particle completes its fall at uniform velocity.

The fall of a body in still water, in still water during a considerable time interval, during a very short time interval; the behavior of a solid body in an ascending current of water, in a descending current of water; the behavior of solid bodies in a stream of water flowing down an incline, are treated in simple mathematics and at length.

The fact that ideal conditions, such as had to be assumed in this study, are hardly ever met with in practice, by no means invalidates the general conclusions drawn. Actual conditions, however, modify the theoretical behavior of bodies in still or moving water in a manner that can be ascertained only by experimental methods, as applied by those investigators to whom reference has been made.

Although the results of experimental methods have demonstrated limitations in the application of theory to practice, as well as discrepancies in numerical values obtained by the two methods, they have, in general corroborated theoretical deductions. They also have made it clear that for an explanation of experimental results, and for an intelligent application of these results to practical problems, a thorough grasp of basic principles is an essential prerequisite.

## Petroleum Resources of Venezuela*

BY RALPH ARNOLD, BARNABAS BRYAN, NEW YORK, N. Y., AND GEO. A. MACREADY, LOS ANGLES, CALIF.

WHILE much geological work and drilling have been done in Venezuela, the incompleteness of geological evidence obtainable and the restricted areas in which drilling has been done make any estimates of oil resources extremely speculative. Nevertheless, it is felt that the data given are justified, in the belief that the ideas of a geologist familiar with the region are better than those of a promoter.

The oldest beds of interest to oil men are those of the Cretaceous, which are well developed in eastern Venezuela and about parts of Lake Maracaibo. In both cases, a hard massive limestone is overlaid by a great thickness, most of which is shale. In the west, in places this shale is more than 2000 ft. thick, while in the east it may attain 3500 ft. The limestone and parts of the shale are oil producing.

In the east, the Tertiary where present is almost entirely covered by the Quarternary, but in the west it is well developed. Over much of Venezuela, the Quarternary is present in unknown thickness, which probably is not great. It obscures oil structure in all cases and presents the greatest hazard of oil exploration for the fields which probably exist below. It is at once a promise and a threat.

From the standpoint of oil production at a profit, the Lake Maracaibo region contains over 95 per cent. of the probabilities of Venezuela. Here the combined action of the major mountain ranges pinched the intervening area to produce the geosyncline of the lake and the surrounding wrinkles that contain the oil possibilities.

In eastern Venezuela, the possibilities are based entirely on geology with only negative evidence from the drill. While work in the region has been done with great care and forethought, the most encouraging

* New York Meeting, February, 1922.

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results have been the discovery of semi-liquid asphalt of no present commercial value. Nevertheless, the evidence is so great that the authors have no hesitancy in saying that oil eventually will be discovered by the drill in commercial quantities.

In the great region south of the mountains, there are evidences of oil and the probability of structure, but the difficulties of transportation and the numerous troubles and costs necessary to the development of oil will prevent these fields from producing at a profit for many years to come.

The oil of Trinidad is found in true sands in the lower part of the Tertiary series, which is well developed in the southern half of the island. The structure is mostly anticlinal, although a few domes have developed oil. Nine fields have been developed by about five hundred wells, about two hundred of which are approximately 3000 ft. deep. One of these fields produces oil of about 40° Baumé while the remainder give a grade running from 14° to 22°. The development area is about 5 sq. mi., or 3200 acres, which will produce about 6250 bbl. per acre. Thus the total production of the known fields will be about 20,000,000 barrels.

As regards South America, it is the writers' opinion that many of us are gazing into a mirage. After visiting a large part of the prospective territory of that continent and having some experience with the costs and difficulties of development, it is the belief of the writers that ten cents spent in increasing the percentage recovery of oil from known American fields will be more productive of profits than a dollar spent in the tropics and that new methods of recovery may double our probable reserves. It is likewise their belief that shale oils produced in the United States can be laid down in the great markets from Chicago and St. Louis westward at less cost per barrel than oil produced from sand-storage fields in the tropics.

Referring to Trinidad, Hubert May, associated with A. Beeby Thompson of London, states:

> Approximately, I should estimate the producing area at about 10 sq. mi.; the possible area may be considered to be the whole of the southern part of the island, or say about 1000 sq. mi., but the probable area will be somewhere in the neighborhood of 200 sq. mi. in area, extending northeast and southwest of Tabaquite, an area bounded on the north by a line connecting Brighton and Princess Town, the eastern and western boundaries being a line drawn from these to a point on the south coast, including the Point Fortin area to the west. A producing area will probably be developed within an area bounded on the east by the coast line, on the south by the coast line, on the north by the Ortoire area, and on the west by a north-south line through Rio Claro. This must naturally be considered approximate, but there is little doubt that production will be obtained from those areas extending from fields already producing.

The total production from Trinidad through the year 1920 was 12,000,000 bbl., leaving the probable production from the developed fields about 8,000,000 bbl. Possible increases in the probable production of known fields may somewhat increase these totals, while other developments in the southern half of the island are, of course, possible, but such possibilities are indefinite at present.

## Petroleum Reserves of Central America*

By Arthur H. Redfield, Washington, D. C.

IN ESTIMATING the unmined petroleum reserves of Central America, it is not feasible to employ the methods that have been worked out in the oil fields of the United States. No producing wells have been brought in and no drilling sections have been made public. It is accordingly necessary to fall back on a crude "barrels per square mile" estimate. The method chosen is a comparison of the structure of the foreign field of unknown reserves with that of some supposedly analogous North American field of which the reserves have been estimated. This method makes no pretense at scientific accuracy; but furnishes a working basis for an estimate.

The areal geology of Central America is illustrated in the maps prepared by Sapper and more recently in the geologic map of North America accompanying U. S. Geological Survey *Professional Paper* No. 71, "Index to the Stratigraphy of North America." Disregarding for the present the narrow Quaternary coastal plains and alluvial deposits of the river valleys, three chief zones may be distinguished. These are: A zone of late eruptive and effusive rocks; a zone of highly folded pre-Cambrian (?) or early Paleozoic crystalline schists and slates, considerably intruded by pre-Tertiary plutonic rocks; and a zone of more or less folded sediments, chiefly of Cretaceous or Tertiary age.

On the basis of a summary of the geology of Central America, the discussion of the probable oil reserves may be confined to three major areas: Central and northern Guatemala and portions of southern and northern British Honduras; certain limited zones in northern and central Honduras; both the Caribbean and Pacific coastal zones of Costa Rica and Panama.

Salvador is excluded because of the predominance of late eruptive and effusive rocks in its geologic structure, and Nicaragua, because of the preponderance of late igneous rocks over three-fourths of its area. In Nicaragua, the known sedimentary rocks are intruded in several places. No well-authenticated seepages occur in the known sediments, which are predominantly shaly in character; and few beds of a carbonaceous character occur. The only area that appears to offer any possibilities of containing sedimentary formations of any considerable extent with favorable structures is the Mosquito Coast (Department of Zelaya); and practically nothing is known about the geology of this area. It is not impossible that limited petroleum reserves exist in Nicaragua, but too little is known of the sedimentary formations of the republic to hazard an estimate as to their extent.

There is in northern Guatemala and certain adjacent portions of British Honduras a broad zone of moderately disturbed Cretaceous and Tertiary sediments. On the

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basis of our present knowledge of Central American geology, this appears to be the most favorable area for oil prospecting in Central America.

The American field to which the Guatemala-British Honduras area presents the closest resemblance is the Cretaceous and Tertiary belt of central Texas, exclusive of the Gulf Coast oil fields.

By ratio of areas, assuming the same relative oil content for the Cretaceous and Tertiary of Guatemala and British Honduras as for central Texas, we may estimate the unmined petroleum reserves of the Guatemala-British Honduras area at a maximum of 38,000,000 bbl. Certain reservations would be wise, however. No effort will be made to estimate the oil reserves of Honduras, which from all the evidence presented are of negligible extent in comparison with the unmined reserves in any one of the minor regions of the United States.

No oil field of the United States offers a close analogy to the geologic conditions of the Costa Rica-Panama area. In the marked unconformities, close folding, and considerable faulting, the oil fields of southern California offer a resemblance. Late igneous intrusions, however, play no part in the southern California oil fields as in the coastal areas of Costa Rica and Panama. The California fields probably do not occur in such close proximity to a cordillera of late igneous rocks. The sediments of the California valleys occupy a wider area and are more continuous than those of the coastal plains and foot hills of Costa Rica and Panama. Accordingly, no satisfactory basis exists for an estimate of the oil reserves of the Costa Rica-Panama area. There are, in all probability, reserves of unmined petroleum in this territory.

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## Oil Resources of Peru*

By V. F. Marsters, Kansas City, Mo.

PERU has produced petroleum since the early seventies, the first work having been started in what is now known as the Zorritos field, in the Province of Tumbes, adjoining Ecuador.

In the early nineties, the Negritos field, in the Department of Piura, came into prominence, and by 1905 had attained an annual production of 335,160 bbl. In 1900 and 1901, the Lobitos field became the scene of marked activity. In 1905, its total production amounted to 75,000 bbl.; it has continued to increase as has also Negritos.

From 1897 to 1902, there was prospecting in the region of La Brieta (or Fernandez), on the Mancora River, about 25 to 30 km. from the coast. Small production of a heavy oil was obtained from three different sands. So far as the author knows, no work has been done in that locality since 1902. There are thus four distinct fields in the north end of the Peruvian coastal plain.

The remaining productive locality of Peru is the Pirin or Pusi field, at the northwest end of Lake Titicaca, Department of Puno, in southern Peru. The maximum annual production was obtained about 1908, estimated at 96,000 barrels.

Peru possesses two distinct geographic provinces in which we may look for the development of a larger oil industry. These provinces are: (1) the coastal plain province; (2) the inter-Andean plains.

Possible, Probable, and Favorable Oil-bearing Territory of Peru

| | Acres |
|---|---|
| 1. Area of the coastal plain of Peru considered as developed and in part proved, approximately... | 30,875 |
| 2. Total promising area outside of the proved areas of the coastal plain, all of this being in the "north-sector"..... | 500,125 |
| 3. Total possible producing area of the coastal plain.. | 1,620,610 |
| 4. Total probable producing area of the coastal plain. | 940,305 |
| 5. Total possible producing area of the Pirin region, Lake Titicaca, Department of Puno..... (The above figures do not take into consideration the territory outside of the general lowland at the northwest end of the Titicaca Lake. It should be stated that Tertiary and Cretaceous formations occupy an enormous area to the northwest and west of the Juliaca-Yaravari-Hauncane district.) | 98,800 |
| 6. Total coastal plain area, approximately..... | 3,091,915 |
| Total interior area, Pirin region approximately.... | 98,800 |
| Total area..... | 3,190,715 |

Apparently little attention has been paid to the possibilities of shale formations of Peru as a source of petroleum.

While investigating coal deposits in Peru, I learned something of the distribution of shales associated with them. It is my opinion that the shale deposits known to exist on the west slope of the Andes in the Department of Libertad and Cajamarca may contain oil-bearing members. I am informed that one section of the west range in the Department of Ancash likewise displays a very considerable thickness of carbonaceous shale.

An analysis of the rate of increase in the annual production of the Republic, considered in terms of new territory recognized as either probable or favorable ground for future development, should render some assistance in formulating a fairly dependable opinion on possible future production.

Inspection of the production data brings out the following conclusions.

1. The Zorritos field showed its maximum production in 1910 with 107,000 bbl. falling by 1915 to 72,736 bbl. By 1918 production had increased to 76,000 bbl., which so far as I know has not been exceeded during the last three years. The production of the field seems to be declining, or at least to have passed its maximum.

2. The figures on the Pirin field would lead the

* New York Meeting, February, 1922.

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casual observer to suspect that the area is practically condemned. On the other hand, detailed investigation will show that it can be made to produce, but geographical conditions render operation difficult.

3. As a rule, the annual production of the other fields has shown a marked increase. The greatest total annual increase of production appears in 1920 and 1921. The peak of annual production of these fields has not yet been reached.

OIL PRODUCTION OF PERU WITH ESTIMATES ON POSSIBLE RESERVES

| | Barrels |
|---|---|
| Total production from 1896 to 1921 | 30,176,355 |
| Total production for 1920 | 2,790,000 |
| Total production for 1921 | 3,568,000 |
| Increase of total production for 1921 | 778,000 |
| Assuming an increasingly active drilling campaign, not only on the known extensions of producing structures, but also on other coastal areas where probably favorable conditions are believed to exist, it is estimated that not less than six years will be required to prove the areal extent of productive territory throughout the entire coast. | |
| Adopting the above increment of production, placed at 770,000 bbl. per annum, Peru should be producing approximately 9,180,000 bbl. annually by 1928. This is regarded as the peak of production for the Peruvian coast. The total production of the Peruvian coast from 1921 to 1928 will approximate 33,818,415 bbl.; hence the total production of the coast from 1896 to 1928 would be | 63,994,770 |
| After proving up the areal extent of producing territory of the coast it is estimated that the peak of total annual production can be held near the maximum for a period of from five to seven years. Hence from 1928 to 1934 we would expect to obtain approximately | 54,000,000 |
| Or a total production from the coast alone by 1934 of | 117,994,770 |
| As to the rate of decrease of production, after the peak has been passed, very little published data seems to be available, but such as we have on the question of permanent *settled* production points to the conclusion that we may expect the passage from the peak to settled production to occupy about two years. On this basis the annual production of the coast by 1936 would be not less than 4,000,000 bbl. Hence, at the close of 1916, the total production of the Peruvian coastal district will be approximately | 128,769,777 |
| The period of settled production is estimated to cover not less than ten years. This period is estimated to make a total showing of 30,000,000 bbl. The total production of the Peruvian coast is therefore estimated at | 158,769,770 |
| For the Pirin area (Lake Titicaca region) the small amount of exploration carried on has resulted in the total production of 284,571 bbl. between 1906 and 1915. It is believed that this region possesses favorable structures and if developed with caution and economy will add not less than 30,000,000 bbl. to the total production of the Republic. This makes a grand total of | 188,769,770 |

Using the available published statistics on production, the preceding summary seems reasonably fair. After making some calculations on the acreage basis, and knowing that from four to seven sands exist in certain fields, the author feels forced to admit that the above figures must be too low.

Applying the few facts at hand to the acreage regarded as probable to favorable territory, the author is confronted with the unsuspected and surprising conclusion that he must increase the final production from 3.5 to 5 times the total given above, or from 660,694,195 to 943,848,850 barrels.

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## Oil Resources of Ecuador*

By V. F. Marsters, Kansas City, Mo.

SEEPAGES of oil in Ecuador have been known for many years. The locality first to receive attention, and still worked in a modest way, lies on the north shore of the Santa Elena peninsula, between La Puntilla and Salinas. Foreign companies acquired large blocks of land, where they have done considerable drilling. For details concerning present drilling activities in Ecuador, we are indebted to Mr. Leon Price, an American resident engineer of Ecuador. The information solicited came to the author through the office of the American Consulate, with permission to use it.

On the south coast there are many seepages, most of them being near the inner edge of the coastal plain, between Zarumilla and Santa Rosa and also between Santa Rosa and Machala. In the latter region are many low places or basins, usually partly filled with water; at times, the pools in these lowlands show oil-films. The author is informed also that a few seepages are known between Machala and Nevasa. It is reported that seepages occur on Puno Island, which, as well as many other islands, is thought to be composed mainly of Tertiary sediments. In reality, it represents a partly drowned section of the coastal plain.

The author has no reliable information upon which to make any calculations on the possible probable or favorable oil-bearing territory at the east foot of the Andes. There is no doubt that oil seepages occur near Yurimaguas, on the Haullaga River, close to the boundary between Peru and Ecuador. Cretaceous and probably Tertiary sediments are thought to occur in this eastern province. Geological conditions are similar to those in the coastal province, and duplicate in part what is reported in the Argentine and Bolivia. Hence one may expect to find oil deposits of commercial importance in the oriental provinces of Ecuador and Peru.

The grand total of *possible* producing territory of the west border of Ecuador would measure approximately 5,091,609 acres. Deducting the interior area from the above total, leaves about 4,081,873 acres to represent a more conservative view of the total. From the stratigraphical data obtained from various sources, it seems probable that not more than 20 per cent. of this

* New York Meeting, February, 1922.

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area may be placed in the "probable" list. Hence, in this case we would have:

| | Acres |
|---|---|
| Possible producing territory, coastal area of Ecuador | 4,081,873 |
| Probable producing territory, coastal area of Ecuador | 1,009,736 |
| Total | 5,091,609 |

A summary of possible to favorable oil territory in the coastal province of Ecuador is given in the following tabulation.

| | Sq. Km. | Acres |
|---|---|---|
| Favorable territory: | | |
| Part of Sta. Elena peninsula | 4,704 | 1,181,888 |
| Possible to probable territory: | | |
| Olan to Palmar (coastal plain) | 5,152 | 1,271,541 |
| San Francisco area (coastal plain) | 1,400 | 345,800 |
| Mira-Santiago area (coastal plain) | 2,800 | 691,600 |
| Guayaquil (coastal plain) | 2,464 | 608,608 |
| Islands, Gulf of Guayaquil | 1,232 | 304,304 |
| Guayaquil to Peru border (coastal plain) | 3,360 | 830,020 |
| Interior belt, Santa Rosa to Peru border | 4,088 | 1,009,736 |
| Total possible to probable | 20,496 | 5,061,609 |

Ecuador possesses but one deep well now "producing." This well is near Ancon, on the south coast of the Santa Elena Peninsula, and was drilled to 2800 ft. It has produced from 37 to 40 bbl. per day. The three wells drilled west of Santa Elena are reported to have been drilled to about 700 ft. and to have produced oil, but the author understands that they are temporarily abandoned.

The main production of Ecuador is obtained from pits near Santa Elena. Mr. Price reports that this amounts to approximately 40,000 bbl. per annum. From these figures, it seems that the Ancon well might produce about 13,000 bbl. per year; adding this to the pit production gives a total of 53,000 bbl. per annum.

Assuming that the extent of favorable, probable and possible territory corresponds in a general way to the area of the coastal plain province, as recognized on the border of Peru, Ecuador may possess more oil-bearing territory than Peru.

## Oil Laws of Latin America*

By Edward Schuster and Frank Feuille, Jr., New York, N. Y.

WE PRESENT only a general idea of the oil laws in the Latin-American republics, as a supplement to Bulletin 206 of the Department of the Interior compiled under the direction of J. W. Thompson of the Bureau of Mines and entitled "Petroleum Laws of All America." We shall attempt to give the main features of such special petroleum legislation as has been adopted prior to the early part of this year; where no special petroleum laws exist, we must look to the Mining Codes for light on the petroleum policy.

* New York Meeting, February, 1922.

As the laws and regulations for the extraction of the metals are often difficult of application to, and are lacking in many essentials for, the petroleum industry, it is best for persons or companies desiring to enter, on a large scale, into the petroleum exploration and development of countries not having special petroleum legislation, to obtain a concession contract from the executive of the country under consideration, and to have the concession approved by the congress. If this concession, which would then be a special law, contains nothing contrary to the constitution of that country and does not infringe on vested rights of third parties, it should be reasonably safe. If in such country there is some doubt as to whether the petroleum subsoil is owned by the nation or the private surface owner, only public lands should be covered with the concession.

Guatemala is the only republic in the group that discriminates directly against foreigners. Bolivia, Ecuador, Mexico and Venezuela require waivers of diplomatic protection. Colombia requires foreigners to agree to be bound by its alien law. In addition, Mexico makes it unlawful for foreigners to acquire direct ownership of real estate, including mines, within a zone of 50 km. along the coasts and one of 100 km. along its land frontiers; and Peru prescribes a like prohibition as to properties within 50 km. of its boundaries.

All of the Latin-American countries have written constitutions, largely modelled on our federal constitution. Their laws are contained mainly in a series of codes; the basic code for property rights in general being the civil code; for commercial matters, the mercantile code; and for mining matters, the mining code.

### Theories as to Mining Property; and Those Prevailing in Latin-America

There are four theories and practices in the world as regards the subsoil:

1. The theory of occupation or appropriation, which considers mines to be *res nullius*, until reduced to ownership by discovery and appropriation; this was the policy premised in the mining laws of the State of California beginning in 1848. It does not prove successful in practice.

2. The doctrine of accession, whereby the surface owner's title includes the subsoil. This was the Roman doctrine and is the English and American doctrine. Under it, the mining industry is controlled by individual enterprise; and it is this liberty of individual initiative that has made the United States the leading mining nation of the world.

3. The pure regalian or royalty theory, under which the government owns the subsoil and exploits it directly or under contracts made with individuals, who cannot acquire anything but working rights, private property in mines not being recognized. This is the Turkish doctrine.

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4. A mixed theory of royalty and appropriation, under which denouncements of the subsoil and issuance of patents carrying a property title are allowed, by permission of the government, and the payment of annual rentals or percentages in the product to the government. The mining ordinances of the Spanish crown issued for the Americas and also the French law of 1810, applied this mixed theory.

As regards the ownership of the petroleum subsoil, the present tendency of the Latin-American countries is such that the courts would sustain the government's claim thereto, unless the legislatures have expressly granted the subsoil to the surface owners, as has occurred in Brazil, Colombia, Mexico and Panama. In Mexico, the present administration has not abandoned the program of confiscation that First Chief Carranza initiated in article 27 of the present Mexican Constitution.

In Chile, Costa Rica, El Salvador, Honduras, and Guatemala, the ownership of the petroleum subsoil is open to question. In Argentine, Bolivia, Ecuador, Nicaragua, Paraguay, Peru, Uruguay, and Venezuela, the question would undoubtedly be decided in favor of the nation. In Mexico, Brazil, Colombia, and Panama, it unquestionably belongs to the owners of the surface who acquired prior to certain dates.

In this connection, we should note that there exists a general tendency in the Latin-American countries, as regards their petroleum legislation, to substitute for the mixed doctrine of royalty and appropriation, inherited from the Spaniards, the Turkish or regalian theory; this tendency is a retrogression. The Turk has never been noted for contributions to the advancement of civilization.

### Countries That Have No Special Petroleum Legislation

Brazil was a Portuguese colony and under the laws of Portugal the mineral subsoil was reserved to the crown. Under the constitution of the republic promulgated in 1891, mines belong to the owners of the surface, subject to regulation by the federal government. As yet, Brazil has no special petroleum legislation, and such exploitation and development as are carried out must be effected under the mining code. Under the provisions of the mining decree of January, 1921, alienations of public lands will not include subsoil rights unless expressly so stated.

Chile is not vitally interested in petroleum. Should petroleum in commercial quantities be discovered in Chile, the past policy of that republic would indicate that its laws to cover the industry would be reasonable.

In El Salvador a law of 1918 declared that the government owns all the mineral subsoil, including petroleum.

The 1895 mining code of Honduras reserves mines to the state but does not mention petroleum. As there is no special petroleum law, the Honduran Executive and Legislative Departments are executing and approving concessions for petroleum exploitation, based on the code of 1895.

Paraguay operates under the mining laws of 1878 and 1914; the state claims the minerals.

In Uruguay the mining code of 1884 reserved mines to the state. There is no petroleum legislation.

In Argentine only the federal government is competent to enact mining legislation and the mining code of 1887 reserves petroleum to the nation.

The petroleum subsoil question in Costa Rica is of uncertain solution. The civil code of 1841 contains a pronounced doctrine of accession; and under the provisions of the mining code of 1868 it would seem that the nation had parted with its petroleum subsoil in favor of the owner of the surface. But a law of 1913 attempts to put petroleum subsoil under the dominion of the nation.

The mining code of Guatemala reserved certain minerals to the nation but did not mention petroleum. The decree of Dec. 10, 1915, known as Decree No. 722, attempted to reserve the petroleum subsoil and stated that it did so, as petroleum was not reserved under the mining code of 1908. Under this statement, it would seem that the petroleum subsoil should be construed as belonging to the owner of the surface except as to public land alienated by the nation after Dec. 10, 1915.

The Mexican mining code of 1884 expressly granted the petroleum subsoil to the owner of the surface and this grant was confirmed by the codes of 1892 and 1909. In 1901, a law was enacted authorizing the executive to grant concessions for the petroleum exploitation of lands and waters under federal jurisdiction. In late years, the attempt has been made, by article 27 of the constitution of 1917, to wipe out the rights of the surface owner to the subsoil granted him by the mining codes of 1884, 1892, and 1909.

As the Mexican congress passed no petroleum legislation based on the new constitutional article 27, President Carranza, in the illegal exercise of purely fiscal powers conferred on him by the congress, issued a series of decrees in 1918 purporting to put into effect the petroleum paragraph of this constitutional article. These decrees are considered illegal by members of the Mexican bar in general, excepting the official element, Nevertheless, the Federal Supreme Court of Mexico decided recently in the Texas Company "amparo" case that they are legal. The present government holds to this confiscation of the petroleum subsoil of the surface owners and attempts to justify its course on fallacious theories of rights in expectancy and retroactivity. To the owner of the subsoil it is immaterial whether the Mexican government declares this article to be retroactive or not, so long as in actual practice and based on a sophistical theory of vested rights it applies the article retroactively.

A petroleum bill is now pending before the Mexican congress but it also proceeds on a palpably false theory

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of vested rights and offers little promise as a solution of the unsatisfactory situation that now exists. The acquisition of petroleum subsoil rights is at a standstill in Mexico as notaries are forbidden to execute contracts covering petroleum subsoil and the registrars of deeds are forbidden to record them should they be authorized.

### Countries That Have Adopted Special Legislation

Bolivia, by a decree of 1872, expressly reversed the petroleum subsoil to the nation and its petroleum laws of 1916 and 1921 reiterated this principle. The law of June 20, 1921, which is at present in force, provides that the petroleum subsoil can be explored and exploited only by the executive power, either directly or in association with individuals or companies.

Under the constitution of 1886, Colombia took over all lands and mines belonging to the several states that had formed its union prior thereto, without prejudice to rights previously acquired by individuals. Under the decree of June 20, 1919, the petroleum in privately owned lands was subject to denouncement; but in the same year the supreme court held that the government, under the constitution of 1886, had acquired only the mining rights held by the states; that these had reserved only mines of gold, silver, platinum, and precious stones and these reservations had been ratified by the mining law of 1887; that petroleum had not been included in these reservations; and hence, that the petroleum subsoil of privately owned lands acquired prior to the law of Oct. 28, 1873, was not subject to denouncement.

The Colombian congress passed Law 120 in 1919, which divides the country into three zones and stipulates royalties, time for exploitation, etc.

The present petroleum law of Ecuador was passed in September, 1921, and authorizes the executive to grant leases not to exceed 20 years from the date on which exploitation begins, with an extension of 10 years, the latter being subject to the laws in force at that time; the royalty to be not less than 5 per cent. nor more than 12 per cent. depending on the zone, and to be paid in kind or money at the option of the executive.

The legislation in regard to petroleum in Panama is in a very unsatisfactory state owing to the existence of three or four laws having conflicting provisions.

The Peru mining code of 1900 reserved all mines to the government except certain non-metallic substances; petroleum was not included in the exceptions. The petroleum law of Jan. 2, 1922, declares deposits of petroleum to belong to the nation.

Under the constitution of 1904, the federal government of Venezuela has all the revenues yielded by mines and public lands. The present petroleum law became effective July 30, 1921; under it, as under previous legislation, the government claims the petroleum subsoil, private ownership in the well not being obtainable. This law makes a distinction between exploration and reserved zones.

It may fairly be deduced from the foregoing that in Latin America the tendency is to encroach upon the rights of the individual and to create a government monopoly in the rights to the petroleum subsoil, either by express legislation or by excessive taxation, and by administrative policy.

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## Canadian Oil Reserves*

By Ralph Arnold and Walter A. English, New York, N. Y.

THOUGH production began in Canada only a short time after the discovery of oil in the United States, it has never attained large proportions, and if we were to judge entirely by the past the reserves of Canada would be put at a very low figure. There are only two areas from which oil is marketed at the present time; one, the old district around Petrolia in southern Ontario, and the other the small Sheep Creek field near Calgary in Alberta. The former district has produced between 200,000 and 800,000 bbl. annually for the past 40 years, recent figures being near the minimum amount. Sheep Creek has produced about 12,000 bbl. annually for the past five years. The known reserves in proved territory in each of these fields are exceedingly small, when considered in terms of world reserves.

The chief hope of Canada for reserves of considerable magnitude lies in the western provinces. Sedimentary rocks similar to those in the productive fields of the United States occupy thousands of square miles in the western provinces, so that it seems likely that somewhere within this great area the peculiar conditions necessary for the presence of oil pools will be found. Prospecting is being carried on energetically by several large companies, as well as by many independents. The Dominion Government, which controls most of the public lands, is pursuing a fairly liberal policy toward the prospector, which should stimulate wildcatting, although the province of British Columbia, which controls public lands within that province, is at present unwilling to give adequate encouragement to make wildcatting attractive.

As there is really no assurance that any productive pools will be found in western Canada, the estimates of reserves are subject to a wide possibility of error. In making estimates, the various areas within which geologic conditions are more or less uniform are discussed separately; the estimates given for each area are not given with the idea that there is a reasonable probability of their eventually proving to be correct. It is hoped that an average of these estimates, taken together with those made for other undeveloped countries, will give a correct total of reserves for all areas considered, even though the estimates are much too large in some cases and too small in others.

The estimates are made by comparing the Canadian areas to geologically similar districts in the United

* New York Meeting, February, 1922.

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States where development has been sufficient to prove fairly definitely what the ultimate resources will be.

The estimates are for the following geographic divisions: Eastern Canada, southeastern and central plains of Alberta and southwestern Saskatchewan, northern plains of Alberta, Rocky Mountain front of Alberta and British Columbia, Mackenzie River District.

| | Possible Area | Probable Area |
|---|---|---|
| Eastern Canada | Probable future production 10,000,000 bbl. | |
| Southeastern and central plains of Alberta and S. W. Saskatchewan | 2580 sq. mi. | 129 sq. mi. |
| Northern plains of Alberta | 2600 sq. mi. | 130 sq. mi. |
| Rocky Mountain front of Alberta and British Columbia | 60 sq. mi. | |
| Mackenzie River District | 1200 sq. mi. | 60 sq. mi. |
| | 6440 sq. mi. | 319 sq. mi. |

## Petroleum Resources of China and Siberia*

By Eliot Blackwelder, Denver, Colo.

FOR the purposes of this paper, the boundaries of China and Siberia will be taken as they stood about 1907.

Except in the Caspian region, it is doubtful if all the oil ever produced in these countries would equal one day's flow of a good Texas well. Considering the vastness of the regions and the variety of strata, it seems strange that these two countries should have made so small a showing in the petroleum industry. No doubt the condition is caused partly by lack of prospecting and of modern methods of development; in larger measure, however, it is evidently because of unfavorable geological conditions over nearly all of east-central and northern Asia.

### China

The known oil occurrences in China are very few. For many years, perhaps a barrel a day has been obtained by primitive methods from wells near the city of Yen-chang in the northwestern province of Shensi. A like amount formerly was obtained from wells bored for salt water in the vicinity of Kia-ting in southwestern Sze-chwan. The little oil was separated from salt water by allowing it to stand in jars. The salt wells yield also considerable natural gas, which is used to evaporate the salt and also for domestic purposes. There is evidence that wells were bored in this part of China before the third century A. D. It is said that more than 1200 wells have been sunk in that district to depths of 1600 to 2000 ft. in connection with the salt industry.

The scarcity of petroleum in China may be ascribed to three general geologic conditions. First, China contains practically no marine sediments of Mesozoic or Cenozoic age; second, the Paleozoic sediments are not for the most part of the types that generally contribute petroleum; third, the rocks of nearly all ages have been strongly folded, faulted, and more or less intruded by igneous rocks in all parts of China except certain areas in the west and northwest.

### Siberia

For the purposes of this paper, Siberia will be understood to include all of Russian Asia, as it was before the war. Of this territory, the most promising part for future oil supply seems to be the extreme southwestern corner, extending from the south end of the Ural mountains southward along the east shore of the Caspian Sea and eastward to the high ranges of Turkestan. This region has been only partly explored, and only a few localities have been drilled, but much oil already has been produced, along the east side of the Caspian Sea, in the province of Uralsk north of that sea, and in the Khotan Basin at the eastern corner of the triangle. In all three localities development has been slow and is still in its infancy. In this general region, marine strata of Cretaceous and early Tertiary ages apparently are widely distributed and have been folded in varying degrees. Under the circumstances, it seems not unreasonable to expect that other valuable and probably large oil fields will be developed in the Aralo-Caspian part of Siberia.

That part of Siberia lying between the Ural Mountains and the Yenesei River is underlain largely by horizontal or slightly disturbed beds of Lower Cretaceous and early Tertiary age. In general, they appear to be thin and, in part, non-marine gypsiferous deposits. There is not much in the descriptions of these beds to suggest that they will prove to be petroliferous. Yet it is possible that in the southwestern extremity of the district they may become productive, because it is not much farther southwest to the oil-bearing Tertiary strata of the Caspian region. Unconformably beneath the Cretaceous lie folded Paleozoic beds, which rise to the surface in the Ural, Altai, and Kirghiz mountains. This region, two-thirds as large as the United States, probably has not been closely investigated by geologists, and most of the Russian reports are inaccessible to Americans.

### Summary

To give even a very rough quantitative estimate of the petroleum to be derived from China and Siberia, in the present state of our ignorance would be unjustified.

China and Siberia have a combined area nearly three times that of the United States. In this vast region indications of the presence of petroleum are found at only a few widely scattered places. Only in the Aralo-Caspian deserts are there developed oil fields in the modern sense of the word. In addition, the island of Sakhalin offers promise of at least minor developments. We do not know even roughly the size of the

* New York Meeting, February, 1922.

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petroliferous districts. We do not know the number of favorable structures in such districts, nor their areas. We know comparatively little of the average yield of the wells obtainable there.

The writer will venture not only the opinion that China will never produce large quantities of oil, but also that Siberia, with the Sakhalin and Caspian provinces, may eventually yield as much oil as Russia south of the Caucasus.

## Possible Petroleum Resources of Philippine Islands*

By Wallace E. Pratt, Houston, Texas

THE Philippine Islands have produced no oil commercially, nevertheless oil is known to be present at various places in the islands. Although all attempts to produce oil commercially have failed, no intelligent, persistent exploration has yet been carried out. The Richmond Petroleum Corpn., a subsidiary of the Standard Oil Co. of California and a syndicate headed by Ralph Arnold are at present engaged in exploring Bondoc Peninsula in Tayabas Province, one of the promising Philippine areas, in a manner that promises adequately and intelligently to test the petroleum possibilities.

How can the petroleum resources of an entirely undeveloped area like the Philippines be estimated, where not even the areal extent of the various geologic formations is known? Obviously no calculated figure for assured future production can be derived. The fact that rocks of the same geologic age and similar composition have been explored and are producing in Borneo, Sumatra, and Java to the south and in Formosa and Japan to the north affect the problem, so that one can obtain some idea of the quantity of petroleum that may reasonably be expected from the Philippines. It is this measure of the possibilities rather than a definite calculation of petroleum reserves that is presented.

On all the larger Philippine Islands, except Palawan, there are definite indications of the presence of oil. Luzon, Leyte, Cebu, Mindanao, and Panay have oil seepages. On Mindoro and Samar inflammable gas is encountered, and on Masbate and Negros there are the same Tertiary (Miocene?) shales that yield oil through seepages elsewhere, and which retain here their petroliferous character. Probably the same shales are present in Palawan, but little geologic exploration has been carried out on this island. The petroliferous shale series is of adequate thickness (3000 ft. or more) and of suitable character to supply commercial quantities of petroleum. Intercalated with the shale beds are sandstones, which would serve as reservoirs. In places, the geologic structure is known to be favorable for the accumulation of oil in these sandstones. Seepages in regions of favorable structure indicate that accumulation has taken place. Other and more convincing evidence, perhaps, is found in the commercial exploitation of petroleum from rocks of the same geologic age and similar character in Formosa and Japan to the north, and in Borneo, Sumatra, and Java to the south.

The petroleum reserves of the Philippines are estimated at from 50,000,000 to 55,000,000 bbl., but it should be remembered that these figures apply to a region that has never produced any oil commercially and about which we have incomplete data and that they are intended to represent only the order of magnitude of the petroleum possibilities.

* New York Meeting, February, 1922.

## Petroleum Resources of Japan

By J. Morgan Clements, New York, N. Y.

PETROLEUM has been known in Japan since at least 668 A. D., for a picture shows the presentation, during that year, to the Emperor Tenchi (Tenji) of "burning water" and "burning earth" by his subjects from Echigo Province, which today is the largest producer of petroleum in Japan. The burning water was doubtless petroleum and the burning earth either bituminous shale or oil-soaked earth or rock from near the oil seepages.

There are five productive oil districts in Japan proper. These are situated in the provinces of Echigo and Shinano, Akita, Totomi, and Hokkaido, and one in Formosa (Taiwan); in each district oil has been produced in one or more fields. Other fields have been tested and found to carry oil, but in such small quantities that the production is not profitable at this time. Some new fields may be discovered in these districts, but the relatively small area of unproved ground precludes the probability that any large fields will be discovered. Of a total daily production in Japan of about 6000 bbl., the oil districts of Totomi, Shinano, Hokkaido, and Formosa (Taiwan) produced less than 100 bbl. and are practically negligible from the point of view of present production. Echigo and Akita are the important fields, producing practically 99 per cent. of all the Japanese oil.

The oil fields of Formosa (Taiwan) are in process of development, a large part of the probable oil territory being reserved for the Imperial Navy, but the developments thus far have not been promising for a large production.

The west coast of the southern part of Sakhalin (Japanese Karafuto) has oil indications but no promising developments have been made thus far. Excellent oil indications have been reported from Tertiary deposits in the Russian part of Sakhalin and the Japanese Government has occupied the territory and proceeded with the development of the oil fields; but from the meager reports filtering through it is now known that these developments so far have not been successful.

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Factors operating against their success have been the difficulty of access and the severity of the climate, which permits the Japanese to carry on their active prospecting for only about 3 months in the year. However, the failure of the Japanese to have developed commercially productive oil fields in Russian Sakhalin, or even their failure to prove their existence, should not be accepted as proof that such oil fields do not exist.

Petroleum, in Japan, is associated in all cases with Tertiary deposits, though every area in Japan underlain by Tertiary deposits has not been found to carry oil. The oil fields are distributed along the seacoast, except in Hokkaido where the Tertiary oil district is in a strip running through the center of the island.

The Echigo and Akita districts produce practically all the oil in Japan.

There are three well-defined oil horizons. The top one consists of shale, sandstone, and conglomerate; the middle one, of shale with thin beds of sandstone; the lowest is subdivided into two subordinate horizons, the top one consisting of sandstone and shale and the lower one of sandstone and shale with tuff beds. The most productive horizons are the middle and lower horizons, in which the sandstone and tuff are the chief oil carriers, though some oil is obtained from the shale.

I have been unable to learn of any estimates of the oil reserves of Japan that have been made by its oil geologists. Moreover, available data regarding the productive areas are so meager, and much more so regarding the non-productive areas, as to make rather presumptive any attempt at a reasonably intelligent guess as to the reserves. Nevertheless such an estimate has been made and is here given under heads of oil from "proved," "probable," and "possible" ground.

| | Millions of Barrels |
|---|---|
| Oil from proved ground | 90 |
| Oil from probable ground | 300 |
| Oil from possible ground | 0–700 |

It may be well to add that the officials of the various government departments interested in the production and use of petroleum in Japan have been discussing an oil policy for Japan, and it is proposed to establish a bureau to carry on investigations and outline and carry through an oil policy that will conserve the oil supply of Japan and, if possible, increase it. This increase, however, can only be brought about by active prospecting of the probable and possible productive areas of Cretaceous and Tertiary sediments, which occupy a much larger area than that which is occupied by the present important oil-producing districts of Japan.

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**American Gold and Silver Institute.**—The formation of the American Gold and Silver Institute, with headquarters in Washington, has been announced. H. N. Lawrie is the managing director. The Institute will concern itself largely with economic problems having a bearing on the production of gold and silver.

## Investigations by the Bureau of Mines*

**Momentary Heating of Inflammable Coal Dusts** (Serial No. 2306). By Guy B. Taylor and E. C. White, with a foreword by George S. Rice.—When the Federal investigation of coal-dust explosions in mines was begun in 1908, following a series of mine explosion disasters in 1907, mining men generally questioned whether coal dust in air is explosive unless "gas" or methane is present, though perhaps in small amounts not detectable by a safety lamp. The experimental tests beginning in 1909 at the Pittsburgh testing gallery, and after 1911, at the Experimental mine, demonstrated to the mining public the explosibility of coal dust in itself. There followed much controversy as to whether the coal-dust particles unite directly with the oxygen of the air, or whether gas is instantaneously distilled from the dust prior to explosive combustion, the gas enveloping each particle and propagating the flame from one to another. This led to the experiments reported in this paper.

The authors believe that the results of two entirely independent investigations, in which radically different methods of igniting the dust cloud were used, show that it is at least possible to inflame coal-dust suspensions in air under conditions wherein the predistillation of gas appears to be so slight that it can not be considered an effective factor in causing ignition. The alternative explanation seems to be a direct attack upon the finely divided dust by oxygen molecules. That the size of the dust particles is an important factor in the relative inflammability of dusts of the same character has long been appreciated. This fact lends weight to the direct-attack hypothesis.

Although in some of the many experiments tried, unmistakable but slight quantities of combustible gas were found after momentary heating of dust by the methods used, this gas was largely carbon monoxide, and no relation could be traced between its relative quantity and the known relative inflammability of the dusts.

**Safety of Mine-type Telephones** (Serial No. 2308). By L. C. Ilsley.—A preliminary investigation has recently been made by the U. S. Bureau of Mines to determine whether or not the ordinary mine-type telephone is entirely safe in gaseous atmospheres. Two well known makes of mine-type phones were purchased for this investigation.

The results of the investigation indicate that the ordinary type of mine telephone, while designed to have a certain measure of dust and moisture tightness, is not an explosion-proof device, and is, therefore, not safe in gaseous atmospheres. The Bureau of Mines stresses the need of the establishment of safety standards for mine telephones that may be required to operate in gaseous atmospheres.

* Reports in full may be obtained from the Director of Bureau of Mines, Washington, D. C. Give serial number.

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# Government Action of Interest to Engineers

## Extract from Weekly Bulletin Issued by American Engineering Council

JUNE 16, 1922

**National Hydraulic Laboratory.**—A bill providing for a national hydraulic laboratory to study flood control and river hydraulics in general has been introduced by Senator Ransdell of Louisiana. This action was taken at the suggestion of John R. Freeman, president of the American Society of Civil Engineers.

**Muscle Shoals.**—The House Military Affairs Committee has made three reports on the various offers submitted for the purchase of this property. A majority of the committee urges that Mr. Ford's offer be accepted if he will consent to the elimination of the Government's equity in the steam power plant on the Warrior River at Gorgas. A bill carrying these recommendations has been introduced in the House. Minority members of the committee recommend acceptance of the Ford offer including the Gorgas plant. Two members of the committee agree with the majority, but believe that even further changes in the Ford offer should be made before it is accepted. It is now believed that the conferees on the Army bill will agree to the $7,500,000 appropriation inserted by the Senate to provide for the reopening of work on the Wilson dam. House leaders have not reached a decision as to whether the bill providing for acceptance of the Ford offer will be allowed to come up for consideration in the near future. The President is reported to have denied that he opposes a vote on the bill at this time.

JUNE 9, 1922

**Coal.**—During the week Secretary Hoover of the Commerce Department has been conferring with coal retailers. They are not entirely pleased with the arrangements made with the operators and are using their influence to have the whole situation taken up at a Congressional hearing. Senator Borah, the chairman of the Committee on Manufacturers of the Senate, apparently is in sympathy with this plan.

**Tariff.**—The Senate reversed the action of the committee in the matter of manganese ore. The Senate committee proposed putting it on the free list but by large vote the Senate itself retained the item on the dutiable list.

**Fixed Nitrogen Laboratory to Have New Director.**—R. C. Tolman has resigned his position as director and will be succeeded by F. G. Cottrell.

JUNE 2, 1922

**Great Lakes-St. Lawrence Waterway.**—The Prime Minister of Canada returned the proposed treaty which was to be the basis of this project to the Secretary of State, with the opinion that the present is not an opportune time for the negotiation of such a treaty. This reply was formally received May 31, and no information could be obtained from the State Department as to whether an additional move would be made by the American Government at this time.

**Coal.**—Mine operators producing coal pledged their whole-hearted support to Secretary Hoover on May 31 when he announced that he is willing to accept full responsibility for an effort to prevent a runaway coal market. He admitted that under existing laws coal operators could not undertake unity of action in the public interest even in the matter of reducing prices, but he said it was in his province as a public official to expect their individual coöperation with him, to the end that consumers of coal may not be made victims of speculators. Mr. Hoover will work through a central committee composed of Alfred N. Ogle, president of the National Coal Association; C. E. Bockus, Clinchfield Coal Corp., George Otis Smith, director of the U. S. Geological Survey; E. A. Holbrook, assistant director of the U. S. Bureau of Mines, and F. R. Wadleigh, in charge of the Coal Commodity Division of the Department of Commerce. District committees will be set up in each of the 18 fields now producing coal.

**Investment and Profit of the Bituminous Coal Mine Operators.**—The Federal Trade Commission has made report on this subject covering the past six months. Figures were collected by the commission itself except for the three years covering the period when it was under court injunction; during that time figures were collected by the National Coal Association. The report shows the average rate of profit for 1916 to 1921 to be 15 per cent. It is based on the average investment per ton of 1126 representative companies scattered throughout the country and producing 32 per cent. of the country's tonnage. The total investment of these companies was $521,250,000.

**Tariff.**—The committee recommendation that cyanide be made dutiable at 10 per cent. ad valorum was defeated and cyanide was put on the free list.

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# Personal Notes and Biographies

**W. L. Dethloff** is with the American Nickel Corpn., at Clearfield, Pa.

**John W. Maller** is managing director of Ingersoll-Rand (India) Ltd., at Calcutta, India.

**William E. Wrather,** of Dallas, Texas, has for several months been teaching at the University of Chicago.

**Hallet R. Robbins** is special field representative of the metallurgical cyanide division, American Cyanamid Co.

**John E. Arthur** is assistant superintendent of open hearths at the Pittsburgh Crucible Steel Co., Midland. Pa.

**W. Ramsey McIver** has gone to South America, as engineer for the South American Development Co. at Zaruma, Ecuador.

**Clarence W. Andrews** is general foreman of the annealing department of the Farrell Works, American Sheet & Tin Plate Co., Farrell, Pa.

**E. T. Corkill,** formerly superintendent of mines for the International Nickel Co. of Canada at Copper Cliff, is now residing at 58 Hogarth Ave., Toronto, Ont.

**William J. Priestley,** recently with the U. S. Naval Ordnance Plant at South Charleston, West Va., is works manager for the Pittsburgh Crucible Steel Co., Midland, Pa.

**E. C. Vigeon,** managing director of the Bede Metal & Chemical Co., Ltd., Hebburn-on-Tyne, England, is visiting mines and metallurgical works in the United States this summer.

**William A. Mudge** has been transferred from the Bayonne works of the International Nickel Co. to the plant at Huntington, West Va., where he is superintendent of research.

**Glenn L. Allen** has completed his work at Las Chispas mill, Arizpe, Son., Mexico, and is with the La Fe Mining Co., Guadalupe, Zac. Mr. Allen is a specialist in ore concentration.

**D. M. Kerr,** recently metallurgist with the New Jersey Zinc Co. at Palmerton, Pa., has moved to Columbus, Ohio, and is with the Jewell-Bassett-Jewell Co., distributors of Studebaker automobiles.

**Olaf P. Jenkins** is taking charge of the geological investigations of the coal fields in Whatcom and Skagit counties, Washington, for the State Division of Geology, Department of Conservation and Development.

**Ellsworth H. Shriver,** who had charge of the construction of the plant and underground development for the Pike-Floyd Coal Co. at Betsey Layne, Ky., is now superintendent of mines for that company.

**Oscar A. Glaeser,** formerly resident engineer of construction for the Alaskan Engineering Commission employed on the construction of the first Alaskan coal washery built by the Government, is assistant mine foreman of the Burnett mine, Pacific Coast Coal Co. of Seattle.

**Holman I. Pearl, E. R. Cullity** and **A. K. Knickerbocker** have joined company in the corporation of Allied Engineers, Ltd. They have reopened the office and assay laboratories at Le Pas, Manitoba, and will maintain an office of the company in the Yegen building at Butte, Mont.

**Henry M. Adkinson** made a short address on the Service of the Mine Promoter—the *real* promoter, not the unprincipled one—at a "get-together" dinner held under the auspices of the Salt Lake stock and mining exchange and the mining committee of the commercial club of Salt Lake City, on April 29.

**Robert K. Painter,** who has been with the General Chemical Co. for eleven years, recently as assistant general manager, has joined with A. V. Schenck and J. D. Stewart to establish a consulting engineering firm at Auburn, Cal. The firm will give particular attention to mine management and development.

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## John C. Branner

JOHN CASPER BRANNER, president emeritus of Stanford University, died on March 1. He had been a member of the Institute since 1884, and contributed various papers and discussions to its TRANSACTIONS. The most recent one, on Oil Possibilities in Brazil, presented at the February meeting, was published after his death.

Dr. John Maxson Stillman, in the *Stanford Illustrated Review*, published a biography and appreciation of Doctor Branner from which the following paragraphs are taken:

Doctor Branner was born in New Market, Tenn., on July 4, 1850. He attended school at Maury Academy in Dandridge, Tenn., and later enrolled at Maryville College. At the age of eighteen he entered Cornell

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University, where he received his bachelor's degree.

While still an undergraduate he was selected (1875) by Professor Charles F. Hartt to assist him in a geological survey of Brazil, which occasioned several years of work in Brazilian geology, so that his degree of B. S. was granted by Cornell in 1882. In 1882, he was commissioned by the United States Government to go to South America to investigate insects injurious to cotton and sugar-cane industries. From 1883 to 1885 he was engaged by the Pennsylvania Geological Survey to make a topographic map of the Lackawanna Valley.

When Dr. David Starr Jordan became president of the University of Indiana in 1885, he appointed his Cornell College and fraternity mate to the professorship of geology at that institution, a position he held until he was again called by Doctor Jordan to the similar chair in Stanford University. In the meantime, however, he acted (1887–1892) as State Geologist of Arkansas, while retaining his chair at Indiana.

From 1891 until his retirement from the university in 1915, Doctor Branner occupied the headship of the department of geology and mining, while holding the office of vice-president of the university from 1898 to 1913. Upon the creation of the title of chancellor for Doctor Jordan in 1913, Professor Branner was elected president, a position which he held until January, 1916, when he also retired under the age limit established by the university, and became president emeritus.

During his years of service at Stanford, Doctor Branner found occasion to direct or participate in professional missions, such as his expedition to Brazil under the patronage of Alexander Agassiz in 1899, and again in 1907–1908. He was also one of the special Government Commissioners on the Panama Canal, and on the California earthquake of 1906.

He received the degrees of Ph. D. from Indiana University in 1885, of LL. D. from the University of Arkansas in 1897, from Maryville College in 1909, and from the University of California in 1915, and the degree of Sc. D. from the University of Chicago in 1916.

His publications are numerous and, while the great majority are on geology, many evidence the breadth of his active interests in botany, entomology, and other lines of natural sciences. His grammar of the Portuguese language (now in its fourth edition) grew out of his Brazilian experience. His bibliography of Clays and Ceramics, an important compilation; the "How and Why Stories," a charming collection of southern negro dialect myths (1921); his genealogy of "Casper Branner of Virginia and His Descendants;" and his recently completed but as yet unpublished translation from the Portuguese of Alexandre Herculano's Establishment of the Inquisition in Portugal, all evidence his breadth of interests and his tireless energy.

As a teacher Professor Branner exerted upon his students an influence which inspired them to their best efforts. His broad experience, his own systematic and untiring research, his realization of the supreme importance of practical experience as the final test of all theories, were well calculated to stimulate the ability and energy of his students, while his simple, sincere, and sympathetic personality attached them to him with a rare devotion.

A very dominant ideal of Doctor Branner was his concept and practice of loyalty. In an address to the students of Stanford in 1908, he said "Without making any fine distinctions, I start with the proposition that loyalty is the most valuable attainment, if we may call it an attainment, or a most valuable trait of character, if that is a better name, that any man or any people can have in this life. . . . You may fairly ask what is to become of loyalty when the conditions make it impossible. One always has a remedy in his own hands; he can quit, and carry with him a gentleman's self-respect, for without that there can be no loyalty worthy of the name. . . . Loyalty is one of the big and far-reaching virtues; it makes trustworthy men and great men; as a national virtue it makes a people great. For if it is love that makes the world go round, it is loyalty that holds the world together."

An editorial in the *Review* says: "There is no need for many words about Doctor Branner for Stanford people. He was one of the creators of Stanford University, a member of its first faculty, its second president. His life has been intertwined with that of all Stanford men and women, and for some contact with him was the greatest influence in the shaping and direction of their lives. None ever knew him without loving him. None ever touched him as a teacher without being moved to seek thoroughness and honesty in their work."

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## John M. Longyear

JOHN MUNRO LONGYEAR died on May 28, at his home in Brookline, Mass. Although he had not been in the best of health for several months, his condition was not considered serious and his death was unexpected.

The rise of Mr. Longyear, from a comparatively poor boy to one of the greatest capitalists of the country is an interesting story. He was born at Lansing, Mich., on April 15, 1850, son of John Wesley and Harriet (Munro) Longyear. His father was a member of Congress, and later was judge of the United States district court at Detroit. The son's early education was obtained in the preparatory department of the Olivet (Mich.) College, at Georgetown (D. C.) College, and at Cazenovia (N. Y.) Seminary.

As a boy he was employed as a lumber sealer in the Saginaw valley. Later he went to Marquette and became a landlooker and timber estimator in the upper peninsula. Perceiving the possibilities of the practically unexplored wilderness, he interested capital and

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gradually acquired extensive holdings of Lake Superior lands rich in iron ore and pine. In 1906, he leased his valuable iron-ore lands to the United States Steel Corpn., for $24,000,000, and even before that was rated as a multimillionaire.

Until 1903, Mr. Longyear lived at Marquette, Mich. He served as mayor of that city in 1890–91, was a member of the Republican state convention in 1890, and became a member of the board of control of the Michigan College of Mines in 1888.

In 1890, Mr. Longyear built a house of native sandstone on the shores of Lake Michigan, and in 1903 removed this residence to Boston. The house was photographed in detail, and was then torn down. Every stone was labeled and protected against chipping, and all were shipped to Brookline on flat cars. The reconstruction attracted the attention of builders throughout the country, and the completed mansion is now one of the show places in New England.

Mr. Longyear always maintained his business headquarters at Marquette, and was frequently in that city. He remained a member of the board of control of the Michigan College of Mines, to which he gave the Longyear Fund to be used by the college to aid students who are unable to maintain their connection with the college without such aid. The laboratories of the college were closed and classes were suspended for the hour during which Mr. Longyear's funeral was being held in Boston.

Mr. Longyear is survived by his wife, who was Mary Hawley Beecher of Battle Creek, Mich.; by two sons, John M. Jr., mining engineer, and Robert D., vice-consul in charge in Hayti; and by three daughters, Mrs. J. R. Richardson-Lyeth of Riverdale, N. Y., Mrs. Alton P. Roberts of Marquette, Mich., and Mrs. Carroll Paul, wife of Lt.-Comdr. Paul, U. S. M. C., Paris Island, S. C.

## Henry Noyes

HENRY NOYES died suddenly at his home near Melbourne, Australia, on March 20, 1922, at the age of sixty-one. Mr. Noyes and his brother, who died two years ago, were Englishmen by birth, sons of the Rev. Thomas E. Noyes, of Creaton, Northhamptonshire. They both had experience in the hardware business in early life, and soon after reaching Australia, in 1888, they commenced business on their own account in Sydney and Melbourne, under the firm name of Noyes Bros. In 1907 two distinct, although related, companies were registered to acquire and continue the business. They held a number of important agencies—British, American and other—and carried out many large engineering works, including the installation or initiation of electric tramways at Dunedin (N. Z.), Fremantle and Adelaide.

Henry Noyes was an authority on steel. He was a member of the Iron and Steel Institute of Great Britain, a member of the American Institute of Mining and Metallurgical Engineers, and of the American Institute of Mechanical Engineers. During the war he took an active part in recruiting, and paid a special visit to England to consult Sir John Monash in reference to that work. He gave large gifts to the Red Cross movement, and at his own cost provided a complete X-ray outfit for use in hospital work.

Mr. Noyes leaves a widow, two daughters and a son. Mrs. Noyes has been a member of the company since its foundation, and she is now a director.

## Askins N. Nicholas

ASKIN M. NICHOLAS, who joined the Institute in 1900, died in Melbourne, Australia, at the age of sixty-one. Mr. Nicholas was a metallurgist, and in later years was particularly interested in filter presses. An account of his life and work is being prepared for publication in this magazine.

## George L. Heath

GEORGE L. HEATH, professor of chemistry at the Michigan College of Mines, died on May 27, 1922, following an attack of pneumonia.

Mr. Heath was born in Montreal, Canada, on April 3, 1866, of American parents. His boyhood was spent in New England, and he graduated with honors from the Massachusetts Institute of Technology in 1888.

After two years as instructor in chemistry at the Institute of Technology, and one year with a chemical company in Brooklyn, N. Y., he spent 31 years as chief chemist and metallurgist for the Calumet & Hecla Smelting Co. at Hubbell, Mich. He joined the staff of the Michigan College of Mines in 1921.

In the short time that he had been at the college, Mr. Heath had made friends among the students and teachers, and the college paper says "they had come to honor and admire him in an unusual degree."

Mr. Heath's wife and son, his mother and a brother and sister, survive him.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month May 15 to June 15, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1920 | Augustine, Albert Bearss | April 7, 1922 |
| 1917 | Goodwin, L. H. | May 31, 1922 |
| 1891 | Heath, George L. | May 27, 1922 |
| 1900 | Nicholas, Askin M. | March 16, 1922 |
| 1899 | Noyes, Henry | March 30, 1922 |
| 1920 | Williamson, James H. | 1922 |

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ZAY JEFFRIES
CHAIRMAN, OHIO SECTION

HENRY M. ADKINSON
CHAIRMAN, UTAH SECTION

EARL R. PEMBROKE
SECRETARY, UTAH SECTION

ROY W. MOORE
CHAIRMAN, NORTHERN ARIZONA SECTION

OFFICERS

OF

LOCAL SECTIONS

WILLIAM B. DALY
CHAIRMAN, MONTANA SECTION

R. S. BILLINGS
VICE-CHAIRMAN AND SECRETARY,
NORTHERN ARIZONA SECTION

J. K. ANDERSON
CHAIRMAN, SOUTHERN WEST VIRGINIA
AND NORTHEAST KENTUCKY SECTION

C. E. KREBS
SECRETARY, SOUTHERN WEST VIRGINIA
AND NORTHEAST KENTUCKY SECTION

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# Institute Affairs

## San Francisco Meeting

A TENTATIVE program for the fall meeting of the Institute, which will be held in San Francisco during the week of Sept. 25, has been arranged by the local section of that city. The General Arrangements Committee is as follows: F. W. Bradley, chairman; C. W. Merrill; T. A. Rickard; F. H. Probert; Fletcher Hamilton.

A number of the local sections of the West have requested that members attending this meeting stop with them for a day *en route*, and in order that members may be given an opportunity to do this with the least inconvenience to themselves and to the members at points visited, it is proposed to arrange for a party to leave New York on Sept. 10. This party may have one or more cars of its own, depending on the number that will attend from east of the Mississippi, and will be managed by an agent of the Raymond & Whitcomb Company.

The tentative program contemplates leaving New York on Sept. 10, passing through Chicago, then on to Denver, with a section meeting at Golden, a day's stop at Salt Lake City, another at Butte, two days in the Coeur d'Alene district, and one day each at Seattle and Portland. The Nevada Mine Operators Association has invited the members to make a side trip to Reno. Arriving at San Francisco on the 24th, the members will hold technical sessions on the 25th at the Engineers Club. F. W. Bradley has arranged for a buffet supper at his home on Monday evening. From Tuesday to Friday inclusive, there will be a trip to the Hetch Hetchy Valley and its water project for a limited number of the visiting men members. During this period there will be alternative trips in the vicinity of San Francisco. Leaving San Francisco, the party will proceed south, will stop at Los Angeles, Kingman, the Grand Canyon and Phoenix, will go over the Apache Trail to Globe, then on to El Paso, St. Louis and return to New York on Oct. 11.

Further detail as to points to be visited and meetings to be held will be worked out when the Secretary is advised of the approximate number that will attend. The cost of the trip will depend also on the number in the party.

The Raymond & Whitcomb Co. have made up an itinerary which includes transportation, pullman, meals while in trains, hotel accommodations without meals where stops are made over night, the Grand Canyon trip and the trip over the Apache Trail, the estimated cost of which is between $651 and $811 per person, depending on the number in the party.

Members will please notify the Secretary of the Institute immediately as to whether they will attend and what accommodations they desire. If this is done early in July final arrangements and definite dates and cost will be available by August 1, when a deposit with the managing company will be required.

Members will please bear in mind that the success of this trip and of the several meetings depends absolutely on their prompt reply to this notification.

The Secretary of the Institute and the secretaries of the local sections are most urgent that members comply with this request.

F. F. SHARPLESS.

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## Registration Fee Plan for Institute Meetings

SINCE the early days of the Institute, the annual meeting in February, generally held in an eastern city, has been the most important business meeting of the year and often the most important technical session. Since the Institute has had a home of its own and has had ample facilities for the annual meeting in New York, it has grown to be still more the big meeting of the year. These meetings, however, have been looked forward to with no keener interest than have the many others held at points distant from New York, and in order that the latter might attract still larger numbers of members local committees have vied with each other in preparing elaborate programs of technical and social entertainment.

Without exception, the courtesies extended by local communities have been fully appreciated, but at times they have been so elaborate as to be a considerable burden on a small group of our members. Some of the older members who have attended many meetings have realized that this annual contribution on the part of a local section is a tax that should not be imposed, and some go so far as to say that it should not be permitted, but that every attending member should pay his share of local expenses which cannot be justly charged to the Institute as a whole.

This feeling has grown to such an extent that it has frequently been the subject of discussion at meetings

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of the Board of Directors, and it has been felt that a registration fee large enough to cover the incidental expenses of a meeting either in the East or the West would be so small per member and would be so helpful to local members in removing a part of their responsibilities that it would be paid gladly by all those attending a meeting.

The directors of the Institute are not alone in this position. The American Chemical Society has followed the registration fee plan for some years and the American Society of Mechanical Engineers has now adopted it, with decidedly beneficial results. With the consent of the San Francisco Section, the pay-as-you-go policy will be adopted at the San Francisco meeting in September.

The welcome to San Francisco will be none the less hearty because of this, and attendance will not be restricted thereby. On the other hand, the knowledge that our San Francisco friends are not footing the bills for all of our entertainment may stimulate attendance by relieving some of us of the embarrassment which is felt when accepting unlimited hospitality. Nor will this method relieve the section of much of its responsibility; the planning and carrying out of a successful meeting entails a large amount of work outside of that of the finance committee.

The registration fee plan, should it become the custom, contains an element of considerable advantage to the Institute as a whole. In the early days of the Institute, while it had few members, three meetings were held annually, but of late it has seldom been the custom to have more than two meetings and with a growing number of members a smaller rather than a larger percentage of members have been able to attend. Contact is the most important element in the success of the Institute work and rather than fewer there should be an increasing number of general meetings held every year, at widely scattered points throughout our broad land.

The necessity of waiting for an invitation from a community feeling sufficiently prosperous to excel in entertainment has debarred the officers of the Institute from holding meetings where they know that meetings ought to be held. With the removal of this deterrent, an imposition on local members, there will be nothing to prevent the Board from suggesting as many meetings as it may wish or from holding them where they will be of greatest benefit to the profession, regardless of the number of local members and their ability to finance a meeting. F. F. SHARPLESS.

## Volume LXVI

VOLUME LXVI of the TRANSACTIONS has been shipped to those members of the Institute who indicated a desire for it. Delivery in foreign countries may be slightly delayed as usual on account of shipping arrangements.

## J. E. Johnson, Jr. Award

THIS award is offered by Mrs. Johnson in memory of her husband "to stimulate and encourage the creative work of young men in engineering, with special reference to the metallurgy of iron and other lines of work in which J. E. Johnson, Jr. was interested." The award will not be made to persons over 40 years of age.

The award is to be made for meritorious research, invention, contribution to professional literature or other activity, and shall be of a nature to bring distinction to the recipient thereof, providing funds to enable the recipient to attend a meeting of the Institute or for such other use as the governing body of the Institute shall determine.

Record of the specific work offered for the award should reach the Secretary of the Institute not later than Sept. 1, 1922.

## Summary of Directors' Minutes

THERE were present at the directors' meeting, on May 19, 1922, 10 directors, 19 invited guests, the secretary and assistant secretary of the Institute.

The question of publication policy for the remainder of 1922 and 1923 was referred to a joint committee consisting of the members of the Executive, Finance and Papers and Publications Committees.

An appropriation of $250 each was made to the Philadelphia and the Columbia Sections.

There were elected 17 Members, 7 Associates, and 37 Junior Associates. The status of four members was changed from Associate to Member, three from Junior Associate to Member and one from Junior Associate to Associate. Nine resignations were accepted.

The minute and resolution, prepared by Bradley Stoughton, in regard to Past President Henry M. Howe, was approved. This was printed in the June issue of MINING AND METALLURGY.

The report of the Library Committee, in accordance with By-law IX, was approved. Amendments to By-law IX were presented and approved, and were ordered to take the statutory course:

An invitation from the San Francisco Local Section to hold the fall meeting of the Institute in San Francisco was unanimously accepted.

The appointment by President Dwight of the following advisory committee on ferrous metallurgy to coöperate with the Bureau of Mines, was approved: R. J. Wysor, Henry D. Hibbard, John A. Matthews, Ralph H. Sweetser.

A letter from Herbert Hoover, Secretary of Commerce, to American Engineering Standards Committee, was transmitted to the directors by George C. Stone, one of the representatives of A. I. M. E. on that committee. Mr. Hoover asked for coöperation in determining what simplification in manufactured products in engineering and technical fields is most

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desirable. It was voted to place this matter before the members by publication in MINING AND METALLURGY.

The request of the Department of Commerce for a representative to be present at the conference on May 24 to consider lumber sizes was referred to the president with power. The president appointed T. T. Read.

## National Research Council Division of Engineering

MEMBERS of the Institute will be interested in the following excerpts from the report of the Division of Engineering, National Research Council, for the year ending April, 1922. The report was compiled by the chairman of the Division, Alfred D. Flinn, largely from reports of committee chairmen.

*American Bureau of Welding*, Professor C. A. Adams, director, through its eleven committees, has aided rapid development in the art. A descriptive pamphlet was printed in November, 1921. The Bureau maintains an information service, and questions and answers of general interest are published in the *Journal* of the American Welding Society.

*Fatigue Phenomena of Metals*, H. F. Moore, chairman.—A comprehensive report outlined by the advisory committee and written by Professors Moore and Kommers, was published in December as *Bulletin* 124 of the Engineering Experiment Station of the University of Illinois. (See MINING AND METALLURGY, Jan., 1922, p. 36; also Report of Engineering Foundation, next page, this number.) Other tests have been made, and a second bulletin is in preparation.

*Heat Treatment of Carbon Steel*, Dr. Henry M. Howe,* chairman.—Funds up to 1921 were provided by the Bureaus of Mines and Standards. The National Research Council appropriated $1000, which was largely used for machining specimens. Doctor Howe's ill health made it impossible for him to continue the direction of this work. F. B. Foley is preparing a complete report for publication.

*Hardness Testing of Metals*, A. E. Bellis, chairman.—The committee on New Hardness Testing Machine, under the chairmanship of Dr. H. L. Whittemore, summarized its work in a paper published in July, 1921, in *Mechanical Engineering*. A committee on Hardness Testing of Metals, organized last autumn, has held two meetings.

*Steel Ingots*, W. P. Barba, chairman.—This committee, organized during the war to determine the best open-hearth practice for the manufacture of gun steels, and fine steels generally, has completed its work. Its report, prepared by Dr. Henry M. Howe* and Colonel Barba, published in January, 1922, by the American Institute of Mining and Metallurgical Engineers, constitutes probably the best specification for acid open-hearth practice ever prepared.

*Neumann Bands*, C. E. Munroe, chairman.—The tests originally planned have been completed, and a report has been prepared by F. B. Foley and S. P. Howell. Research will be continued.

*Substitute Deoxidizers*, J. R. Cain, chairman.—Hereafter will be named Committee on Deoxidizers. Laboratory tests of fusibility and viscosity have been finished. Manufacture of the most promising mixtures and their trial on a small scale in steel making has been under way. The Bureau of Standards is coöperating and has recently assigned an assistant to this investigation. Funds are needed.

*Uses of Tellurium and Selenium*, Victor Lenher, chairman.—Possible use in "anti-knock" compounds for gasoline engines of aircraft and automobiles, is being investigated. Recognized methods for determining selenium and tellurium in ores and products are being prepared for publication.

*High-speed Tool Steel*, J. V. Emmons, chairman.—Lack of progress in research is reported to be due, during the past year, to the increase of regular duties and reduction of staffs of the members. The chairman suggests employment of a secretary on part time, to assist the chairman and continue editorial work on the bibliography.

*Pulverizing*, Galen H. Clevenger, chairman.—The Division's committee was merged with the Milling Committee of the American Institute of Mining and Metallurgical Engineers some time ago. The great depression in the mining industry seriously interfered with raising funds. The Bureau of Mines has agreed to assist through members of its staff, and to pay one-half the salary of a man to devote his whole time to the committee. The Bureau has requested the committee to act as an advisory board on milling and pulverizing and to select five subjects of investigation for Bureau of Mines Fellows for 1923. Several universities have offered the facilities of their laboratories. The committee has undertaken to standardize methods of conducting sizing tests.

*Molding Sand*, R. A. Bull, chairman.—The research initiated last spring has been organized with the hearty support of the American Foundrymen's Association and interested industries.

## Officers and Committees

WITH this number of MINING AND METALLURGY we are mailing a pamphlet containing the list of officers and directors of the Institute, the complete personnel of all Institute committees and committees on which the Institute has representation, and a list of affiliated student societies.

* Deceased.

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## Book Resources of Engineering Societies Library

COMBINATION of the libraries of the Founder Societies provided the Library with a book collection of great value, although not developed with equal fullness along all lines, but fortunately rich in early material, much of which would not be obtainable today. Attention had been specially directed to periodical literature, with the result that complete or nearly complete sets of all the more important periodicals were at hand.

Every effort is being made to complete the collection by acquiring all important new publications, foreign as well as domestic, as soon as they appear, while at the same time conspicuous lacunae are being filled as opportunities arise. With this end in view, the publishers' lists of new books are examined systematically week by week and the important ones ordered. Technical journals are examined for notices of reports and other publications. Readers are encouraged to suggest books that are needed.

Through these agencies the Library keeps informed of new books and is enabled to decide what to purchase. It is not able to spend as much for books as it would like, but must select with extreme care; still it succeeds in getting the essential literature. Particular attention is given to current magazines, it being realized that these are essential for prompt information on current practice.

Deducting material withdrawn for various reasons, the stock on Dec. 31, 1921, was:

| | |
|---|---|
| Volumes | 118,980 |
| Pamphlets | 34,091 |
| Maps and Plans | 555 |
| Manuscript Bibliographies | 3,904 |
| Total | 157,530 |

The small amount of money that can be used to buy books would cause more serious embarrassment were it not for the help received through gifts. The most important of these are the copies of new publications supplied for reviewing in Society journals, by the chief American publishers as well as by some European ones.

## Conference on Non-ferrous Alloys

THE Advisory Committee on Non-ferrous Alloys of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers conferred with representatives of the U. S. Bureau of Mines on April 25. This was the second meeting held for the purpose of developing a program of coöperation between the non-ferrous metal industries.

The conference discussed the question of the functions and possibility of development of the proposed Alloys Research Association, now known as the Alloys Research Information Service. The original proposal was that contributions of $250 should be made by firms in the non-ferrous metal industry to promote a central information service. Definite action was postponed until conditions improve.

The work of the Ithaca station of the Bureau of Mines on the effect of inclusions on the endurance of alloy steels was outlined by Dr. H. W. Gillett.

The question of refractories for the Ajax-Wyatt furnace was brought up by William B. Price of the Scovill Mfg. Co. It was suggested that the interests and information of companies working on the problem be pooled, and the facilities of the ceramic section of the Bureau of Mines were offered as a clearing house for this information.

Dr. R. B. Moore, chief chemist of the Bureau of Mines, outlined a proposed plan of investigation by the steel industry, the Bureau of Mines and the Bureau of Standards in regard to the effect of inclusions on the fatigue resistance of steel.

The desirability of investigating copper-lead alloys was discussed.

R. J. Anderson, metallurgist of the Bureau of Mines, outlined the results of recent work at the Pittsburgh experiment station in regard to the contraction of aluminum alloys; removal of stress in brass tubing; heat treatment of cast non-ferrous alloys.

Clyde E. Williams, superintendent of the Northwest experiment station of the Bureau of Mines, gave an account of experiments made on preparing cast iron from sponge iron and steel scrap in the electric furnace, particularly as to the effect of various factors on the rate of carbon absorption.

The possibility of the preparation of copper-iron alloys to replace brass was suggested, but the general feeling was that there are no possibilities in this direction.

The so-called super-refractories were discussed, and the statement was made that certain of these, such as synthetic spinels, had been worked out successfully on the Pacific Coast.

Lieut. Commander Bowson said that the Bureau of Ordnance is having difficulty in obtaining a suitable container for the illuminant in illuminating projectiles, and that a container that will burn down at about the same rate as the illuminant is desirable.

## Report of Engineering Foundation

THE annual report of Engineering Foundation for 1922, the seventh year, together with a report on the Research on the Fatigue of Metals, illustrated by many halftone cuts and diagrams and amplified by tables, has been issued as Publication No. 4 from the Foundation offices in the Engineering Societies Building. A frontispiece gives the photogravure portraits of the presidents of the four Founder Societies.

Copies of this publication will be mailed on application.

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# Local Sections and Affiliations

## Columbia Section

THE May and June meetings of the Columbia Section were devoted to the discussion of subjects of local interest, regarding meetings, regular and intermittent, how best to serve all the members of the section during the year, and the best method of aiding the Junior Associate members, both as to work during vacation and after graduation.

## Officers of Southern California Section

THE annual meeting of the Southern California Section was held on May 26. The following officers were elected: chairman, Harry R. Johnson; vice-chairman, J. Nelson Nevius; secretary-treasurer, Desaix B. Myers; members of executive committee, Walter A. Schmidt, L. F. S. Holland, W. L. McLain, L. W. Wickes.

## San Francisco Section

THE regular meeting of the section was held on May 9. The chairman, Albert Burch, presided. Report of the committee on the question of a referendum vote which would bring out the sentiment of the majority of the members relative to the continuation of the publication of MINING AND METALLURGY was read. Motion to adopt the first question of the questionnaire proposed by the committee was amended to the effect that the secretary be instructed to circularize the members of the section and ascertain whether a referendum be taken on the questions submitted. The motion was lost, and the report of the committee was filed.

## Chicago Section Meeting with Other Societies

A JOINT meeting of the Chicago Section of the American Institute of Electrical Engineers, the Western Society of Engineers, and the Chicago Section of the American Institute of Mining and Metallurgical Engineers was held in the rooms of the Western Society of Engineers on the evening of May 22. Electricity applied to mining was the subject of the meeting, the papers presented referring to the relative advantages and disadvantages of the production of power on the property as opposed to central-station generation and the purchase of power from a public service corporation. The papers were as follows:

The Use of Central Station Power in Coal Mines, by J. C. Damon, of the West Penn Power Co.
The Use of Purchased Power for Coal Mine Operations, by W. C. Adams, electrical engineer with Allen & Garcia, Mining Engineers.
Purchased Power for Coal Mines, by J. Paul Clayton, vice-president, Central Illinois Public Service Co.

Bradley Stoughton, past secretary of the Institute, was present, and spoke a few words.

At this meeting, the annual election of officers and directors of the section was held. Arthur D. Terrell was chosen for the office of chairman, and the other directors elected were: Luther V. Rice, Howard T. Walsh, William Ryer Wright and Francis G. Fabian.

## Institute of Metals Division Meeting in June

THE Institute of Metals Division had a most successful meeting in Rochester, N. Y., in connection with the American Foundrymen's Association, during the first week in June. The Non-ferrous Section of the A. F. A. combined its meetings with the Institute of Metals Division. The meetings were well attended and the discussion was lively.

The exhibit of the American Foundrymen's Association was held at Exposition Park, about 15 minutes ride from the center of the city, and the buildings in which it was held were ideally situated for such an affair. Over 2000 people attended. The technical sessions were also held in Exposition Park, a few minutes walk from the exhibit.

On Monday evening, the past and present officers of the Institute of Metals Division held a dinner meeting at which 15 were present. On Wednesday evening, there was a banquet, at which Governor Allen, of Kansas, gave a most interesting talk on the industrial court of that state. A large steamer of the Canadian Steamship Lines was chartered and turned over to the delegates on Thursday for a boat ride across Lake Ontario which was enjoyed by everyone present. A run of approximately 50 miles was made to Cobalt, Ont., leaving the dock at Summerville, near Rochester, at 1.30 p.m., returning at 11.00 p.m. Refreshments for both luncheon and supper were furnished on the boat. The Rochester Local Committee is to be congratulated on the success of this boat ride.

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The technical sessions in which the Institute of Metals Division participated were as follows. Members of the Institute of Metals Division may obtain copies of the papers that have been printed from the A. I. M. E.; members of the American Foundrymen's Association may obtain them from C. E. Hoyt, secretary of the A. F. A.

### A. I. M. E. General Metallurgy Session

Chairman, W. B. Price

Physical Properties of Cartridge Brass, by C. Upthegrove and W. C. Harbert.
*Effects of Impurities on Electrolytic Zinc, by G. D. Scholl.
*Mechanism of Metallic Oxidation at High Temperatures, by N. B. Pilling and R. E. Bedworth.
*Extreme Sensitiveness of the Action of Reducing Atmospheres on Heated Copper, by T. S. Fuller.
Some Electrical Properties of Nickel and Monel Wires, by F. M. Sebast, M. A. Hunter and A. Jones.

### A. F. A. Brass Foundry Session

Technical Control of McCook Field Foundry, by E. H. Dix, Jr.
Selection of Fuels and Furnaces for Melting Copper and Brass Alloys, by T. H. A. Eastick.
Porosity of Non-ferrous Metals, by R. R. Clarke.
Investigation of Segregation with a View to Preventing its Occurrence in Castings made of High-lead Bronze, by R. E. Lee and F. B. Trace.
Brass Forgings, by C. G. Heiby.
Two-part Castings Made in Three-part Molds, by W. H. Parry.
History of Monel Metal and Nickel, by W. M. Corse.

### Joint A. F. A. and A. I. M. E. Aluminum Session

Cracks in Aluminum-alloy Castings, by R. J. Anderson.
Effect of Impurities on Oxidation and Swelling of Zinc-aluminum Alloys, by M. M. Pierce and H. E. Brauer.
Use of Secondary Aluminum Ingot in Foundry Practice, by W. M. Weil.
Aluminum and Aluminum-alloy Melting Furnaces, by R. J Anderson.
Melting Aluminum for Rolling into Sheet, by J. A. Lange.

### A. I. M. E. Brass Foundry Session

Chairman, W. B. Price

Temperature Problems in Foundry and Melting Room, by John P. Goheen.
Core-oven Tests, by F. L. Wolf and A. A. Grubb.
Occurrence of Blue Constituent in High-strength Manganese Bronze, by E. H. Dix, Jr.
Gas Absorption and Oxidation of Non-ferrous Metals, by Bruno Woyski and J. W. Boeck.
*Some Interesting Unsolved Problems of the Foundry, by W. M. Corse.
*Foundry Difficulties, by Adolph Bregman.

## Affiliated Student Societies

**South Dakota State School of Mines.**—The Drill and Crucible Club held a meeting on May 18, at which Dr. C. S. Bisson spoke on Chemistry and the Extraction of Radium and Prof. J. P. Connolly spoke on the Geology of the Ores of Radium.

**Pennsylvania State College.**—The Mining and Metallurgical Society held a meeting on May 19. C. Law Watkins, vice-president and general manager of the Penna. Coal & Coke Corpn., made an interesting address on Coal Mining as a Career.

**University of Wisconsin.**—The Mining Club held its last meeting for the school year on May 10. Officers elected for the coming year are: N. H. McKay, president; C. F. Larson, vice-president; M. M. Garrow, secretary-treasurer; A. B. Covell, mucker; G. E. Wiggers, assistant mucker; W. W. Boley, Polygon representative; M. H. Hawkins, publicity.

The retiring officers are: W. F. Uhlig, president; A. M. Hill, vice-president; N. H. McKay, secretary-treasurer; M. M. Garrow, mucker; W. W. Boley, assistant mucker; E. W. Jones, publicity; S. Buckstaff, Polygon representative.

A pin for club members was adopted, to consist of a red enamel "W" on the gold cross hammers of the Institute.

* These papers are not available.

## Woman's Auxiliary

SINCE the meeting of the Board of Directors of the W. A. A. I. M. E. on May 4, reports have been received as follows:

*Educational Committee.*—The joint scholarship from Columbia University and the Woman's Auxiliary has been awarded to Ray S. Jones of the Montana State College, Bozeman, Mont.

*Northern California Section.*—The regular monthly luncheon was held on April 26. Fifteen ladies were present.

The treasurer's report showed $12 received from new and renewed memberships and $5 from Mrs. F. W. Bradley for the Study Fund.

Mrs. Bradley was elected chairman of the section, Mrs. Jüssen having resigned that office because of her proposed absence from the city for several months. A vote of thanks was extended to Mrs. Jüssen for her interest and untiring efforts on behalf of the organization.

After interested discussion, it was voted that an annual assessment of two dollars be made to cover the work to be done for the Study.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Congress on Industrial Chemistry | Marseilles, France | July 2-7 |
| 13th Intl. Geol. Congress | Brussels, Belgium | Aug. 10-19 |
| Iron and Steel Inst. | London, England | Sept. 5-7 |
| Amer. Electrochem. Soc. | Montreal, Que., Canada | Sept. 21-23 |
| Amer. Soc. for Steel Treating | Detroit, Mich. | Oct. 2-7 |
| Amer. Mining Congress | Cleveland, Ohio | Oct. 9-14 |

## Stainless Steel

THE Engineering Societies Library has complied a short list of references to articles on stainless steel, copies of which will be sent gratis to anyone interested.

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# Increase of Membership Department

**Total membership as of June 10, 1922, is 10,093**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period May 15 to June 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—Robert de la Bouglise,** Paris, France.
Present position—1918 to date: President, Société Anonyme des Forces Hydrauliques and Compagnie Minière of French Guinea.
Proposers: Militiades Armas, James F. Kemp, A. C. Burrage.

**2—Albert Ernest Brugger,** Brussels, Belgium.
Present position—1919 to date: Manager, Forminiere-Bueka, Kasai Diamond Fields, Belgian Congo.
Proposers: S. H. Ball, John M. Sully, Charles W. Boise, M. K. Shaler.

**3—Charles McKinnon Campbell,** Cassidy, B. C., Canada.
Present position—1921 to date: Resident Manager, Granby Co.
Proposers: P. E. Peterson, Ned. E. Nelson, H. S. Munroe, J. Austen Bancroft.

**4—Walter Erling Coan,** Fillmore, Ventura Co., Cal.
Present position—1918 to date: General Superintendent, Oak Ridge Oil Co., Montebello Oil Co. & Homestead Development Co., Los Angeles, Cal.
Proposers: Chester Naramore, A. W. Peake, F. S. Hudson.

**5—Ralph Louis Duff,** Roselle, N. J.
Present position—1919 to date: Metallurgist, Standard Oil Co. of New Jersey, Bayway Refinery, Elizabeth, N. J.
Proposers: Walter C. Smith, G. A. Reinhardt, A. N. Diehl, Isaac Harter, Jr.

**6—Arthur Byron Emmanuel,** Gilbert, Mingo Co., W. Va.
Present position—1920 to date: Engineer in charge, all surveys, Gilbert Coal & Coke Co., Gilbert, W. Va. and Alma Thacker Fuel Co., McCarr, Pike Co., Ky.
Proposers: Herbert B. Husband, R. C. Cofer, L. A. Gates.

**7—Leland Emberson Fiske,** Lexington, Ky.
Present position—1921 to date: Geologist, Petroleum Exploration, Sistersville, W. Va.
Proposers: Virgil O. Wood, Erasmus Haworth, Frank R. Clark, Earl A. Trager.

**8—Hamlin Brooks Hatch,** St. John's, Newfoundland.
Present position—1918 to date: Chief Geologist, Natural Resources Department, Reid Newfoundland Co., Ltd.
Proposers: J. B. Tyrrell, R. B. Watson, T. R. Finucane.

**9—Francis Woodall Hogan,** Ft. Worth, Tex.
Present position—1920 to date: Associate Professor of Organic Chemistry, Texas Christian University.
Proposers: W. M. Winton, Chester A. Hammill, Carlton Meredith.

**10—George Francis Holmquist,** Bristol, Conn.
Present position—Engineer in charge of electric furnace construction, Bristol Brass Plant.
Proposers: W. C. Hardy, Lester A. Lanning, F. B. Coyle.

**11—Joseph Francis Joy,** Pittsburgh, Pa.
Present position—President, Joy Machine Co. and Joy Manufacturing Co.
Proposers: J. W. Paul, R. Z. Virgin, J. A. Durkee.

**12—Karl Paul Krueger,** Los Angeles, Cal.
Present position—Unemployed.
Proposers: C. L. Berrien, E. M. Norris, W. B. Daly.

**13—Ervin R. Lederer,** New York, N. Y.
Present position—Consulting Petroleum Engineer.
Proposers: C. W. Van Law, Edward L. Blossom, Harry J. Wolf.

**14—William Clyde McCall,** Logan, W. Va.
Present position—Consulting and Mining Engineer, Logan County Coal Field.
Proposers: Howard N. Eavenson, Thomas F. Downing, C. E. Krebs, W. H. Cunningham.

**15—Hiram Tousley Matson,** Fukuoka-ken, Kiushiu, Japan.
Present position—Engineer, Taio Gold Mining Co.
Proposers: S. J. Kidder, Augustus Locke, Albert Burch.

**16—Archibald Forbes Meston,** Brooklyn, N. Y.
Present position—1921 to date: Research Engineer, De Laval Separator Co.
Proposers: Chester Naramore, Barnabas Bryan, F. G. Cottrell.

**17—Albert Harrison Morrill,** New York, N. Y.
Present position—Unemployed.
Proposers: John E. Kelly, H. J. Volker, Samuel Melitzer.

**17a—Walter Eugene Plankenhorn,** South Williamsport, Pa.
Present position—1921 to date: General Manager and Treasurer, Penn Garment Co., Inc.
Proposers: Charles Enzian, Harry Montz, A. J. Baldwin.

**18—Maganti Vasudeva Rao,** Gorumahisani, B. N. R., India.
Present position—1920 to date: Superintendent of Labor B. P. Byranyi and Co., Bengal, Behar and Orissa Mines and Mining Contractors to the Tata Iron and Steel Co. Ltd., India.
Proposers: H. J. Volker, E. Parsons, E. H. Dickenson.

**19—Faustino Roel,** Mexico City, Mexico.
Present position—1920 to date: Assistant Secretary of Highways and Communications for Mexican Federal Government.
Proposers: J. R. Woodul, Heath Steele, R. F. Munoz, Edward K. Judd.

**20—S. Sonoda, Inari,** Near Kyoto, Japan.
Present position—1919 to date: Owner of the Sonoda Copper Rolling Mill Works.
Proposers: Gaichi Yamada, K. Ide, Tatsuro Otagawa.

**21—Mark Walker,** Los Angeles, Cal.
Present position: Research Chemist for the Pacific Roessler and Hasslacher Chemical Corpn.
Proposers: Walter A. Schmidt, Rush T. Sill, S. K. Dahl.

**22—Edward Arthur Nichols Young,** Republic, Pa.
Present position—1912 to date: Superintendent of Mines, Hillman Coal & Coke Co., Pittsburgh, Pa.
Proposers: M. D. Cooper, W. L. Affelder, G. H. Dieke.

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### Associates

**23—Gerard Linsley Bayles,** Easton, Pa.
Present position—1921 to date: North Butte Mining Co., Butte, Mont.
Proposers: Robert Linton, R. M. Atwater, Jr., Edward E. Thalmann.

**24—Hiroshi Sawamura,** Kyoto Imperial University, Japan.
Present position—1921 to date: Assistant Professor of the Dept. of Mining and Metallurgy.
Proposers: K. Ide, Michiya Hiraoka, Tatsuro Otagawa.

### Junior Associates

**25—Everett Harmen Allison,** East St. Louis, Ill.
Student, University of Illinois.
Proposers: Ray W. Arms, H. H. Stoek, A. E. Drucker.

**26—Lawrence Barber Bennett,** Columbus, O.
Student, Ohio State University.
Proposers: H. E. Nold, William J. McCaughey, D. J. Demorest.

**27—Frank Oswald Bigelow,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: A. E. Adami, Theo. Simons, Horace T. Mann.

**28—Kiel Bert Bowman,** Bowling Green, O.
Student, Case School of Applied Science.
Proposers: Herbert M. Boylston, A. W. Smith, Anthony Jenkin.

**29—John D. Brumbaugh,** Moultrie, O.
Student, Case School of Applied Science.
Proposers: A. W. Smith, Herbert M. Boylston, Anthony Jenkin.

**30—Ezekiel Blair Confer,** Howard, Pa.
Student, Pennsylvania State College.
Proposers: William R. Chedsey, E. S. Moore, D. F. McFarland.

**31—Ray Littleton Farabee,** University, Ala.
Student, University of Alabama.
Proposers: W. M. Wiegel, L. L. Turley, H. D. Pallister.

**32—Cedric Paul Faubel,** Lakewood, O.
Student, Case School of Applied Science.
Proposers: Herbert M. Boylston, Anthony Jenkin, Kenneth Donaldson.

**33—Elmer Louis Groth,** Cleveland, O.
Student, Case School of Applied Science.
Proposers: Herbert M. Boylston, Anthony Jenkin, Kenneth H. Donaldson.

**34—Clarence William Guth,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, C. Y. Pfout, F. M. VanTuyl.

**35—Walter Guy Knox,** Clear Lake, So. Dak.
Student, South Dakota School of Mines.
Proposers: Bancroft Gore, W. C. Bochert, Charles Bentley.

**36—Arthur Rhea Little,** Petersburg, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, Benjamin L. Miller.

**37—Harry Lowenstein,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. M. VanTuyl.

**38—Clarence J. Manley,** Georgetown, Ill.
Student, South Dakota State School of Mines.
Proposers: Bancroft Gore, W. C. Bochert, Charles Bentley.

**39—Ricardo Bentin Mujica,** Lima, Peru, S. A.
Present position: Student, Engineering School of Lima.
Proposers: Luis F. Diaz, Manuel B. Llosa, Jose J. Bravo.

**40—Wayne Gilder O'Harra,** Rapid City, So. Dak.
Student, South Dakota State School of Mines.
Proposers: Charles Bentley, Bancroft Gore, Joseph P. Connolly.

**41—Bates Kelsey Shedd,** Lead, S. Dak.
Student, South Dakota School of Mines.
Proposers: Bancroft Gore, W. C. Bochert, Charles Bentley.

**42—Philip John Shenon,** Salmon, Ida.
Student, University of California.
Proposers: Lester C. Uren, Frank H. Probert, W. S. Morley.

**43—Robert Yoshua Spiers,** Middletown, Lake Co., Cal.
Student, Stanford University.
Proposers: W. F. Dietrich, Theodore J. Hoover, Welton J. Crook.

**44—Clayton Pierce Staples,** Santa Cruz, Cal.
Student, College of Mining, Berkeley, Cal.
Proposers: Frank H. Probert, Walter S. Weeks, Lester C. Uren.

**45—William Henry Tavenner,** Washington, D. C.
Student, Lehigh University, Bethlehem, Pa.
Proposers: Howard Eckfeldt, Benjamin L. Miller, A. Henry Fretz.

**46—Howard Irvin Vormelker,** Cleveland, O.
Student, Case School of Applied Science.
Proposers: Herbert M. Boylston, Anthony Jenkin, Kenneth H. Donaldson.

### Change of Status—Junior Associate to Member

**47—Clarence Ward Andrews,** Sharon, Pa.
Present position: General Foreman, Annealing Dept., American Sheet and Tin Plate Co., Farrell Works, Farrell, Pa.
Proposers: Fred Crabtree, Edward Steidle, Charles R. Fettke.

**48—Ezra E. Erich,** San Francisco, Cal.
Present position—1919 to date: Mining Engineer, Operating and Examining Mining Properties for A. Locke.
Proposers: Theodore J. Hoover, Guy N. Bjorge, Augustus Locke.

**49—Arturo C. Fernandez,** Monterrey, N. L., Mexico.
Present position: In charge exploitation and development of Amalias manganese mining properties, which belong to my brother and myself.
Proposers: C. R. Forbes, H. A. Buehler, M. H. Thornberry.

### Change of Status—Junior Associate to Associate

**50—Frank Donavon Cannon,** Butte, Mont.
Present position: Safety Engineer, Berkeley Mine, Anaconda Copper Min. Co.
Proposers: Theodore Simons, A. E. Adami, C. W. Goodale, John C. Gaul, William B. Daly, John Edward Norton.

**51—Donald C. Gilbert,** Santa Ana, Cal.
Present position: Professional work, Holbrook Prospective Oil Field, Arizona.
Proposers: H. E. Nold, Reno H. Sales, M. H. Gidel.

**52—Mowry Eugene Goetz,** Woodlawn, Pa.
Present position: Senior Melter Foreman, Open Hearth Dept., Jones & Laughlin.
Proposers: E. S. Moore, D. F. McFarland, A. M. Rodgers.

**53—Harry Hotchkin,** Chicago, Ill.
Present position—1920 to date: Petroleum Geologist in New Mexico, Texas and Oklahoma. Associated with H. H. Adams, Consulting Petroleum Geologist.
Proposers: F. W. McNair, H. H. Adams, F. W. Sperr.

**54—Theodore I. Linn,** Tsinan City, Shantung, China.
Present position—1920 to date: Dean of Shantung Mining College, and Lecturer in Shantung Christian University.
Proposers: Howard Eckfeldt, Benjamin L. Miller.

**55—Sinclair Holt Lorain,** Kennecott, Alaska.
Present position—1921 to date: Shift Boss, Mother Lode Mine.
Proposers: F. W. McNair, Walter E. Hopper, F. W Sperr.

**56—James Wilson Rice,** Fort Benjamin Harrison, Ind.
Present position: Captain, Chemical Warfare Service, Corps Area Chemical Officer, Fifth Corps Area.
Proposers: F. C. Lincoln.

## Do You Know Where These Men Are?

| Name | Last Address of Record from Which Mail Has Been Returned |
|---|---|
| Aiken, Charles Wilson | Production Engr., Stromberg Motor Devices Co., Chicago, Ill. |
| Ainsworth, Robert E. | General Delivery, Globe, Ariz. |
| Appleton, John R. | Colorado School of Mines, Golden, Colo. |
| Armstrong, Clifton T. | Pachuca, Hidalgo, Mexico. |
| Baird, David Birch | Sigma Phi Epsilon House, State College, Pa. |
| Barcus, Walter J. E. | Care Hotel Tivold, Panama Canal Zone. |
| Bell, Frank R. | Bartlesville, Okla. |
| Block, James A. | Resident Engr., Thacker Fuel Co., New Thacker, W. Va. |
| Blow, John J. | 404 High Holborn, London, W. C., England. |
| Bradley, D. H., Jr. | Box 93, Prescott, Ariz. |
| Brennon, John C. | 103 East 84th St., New York, N. Y. |
| Carns, Foss D. | Arizona Binghamton Copper Co., Stoddard, Ariz. |
| Chang, C. L. | 370 W. 118th St., New York, N. Y. |
| Chang, Ko Chi | Student, Carnegie Inst. of Tech., Pittsburgh, Pa. |
| Chu, S. Y. | Columbia Univ., New York, N. Y. |
| Cleland, George A. | Miazza Woods Bldg., Meriden, Miss. |
| Crane, Guy Walter | Chief Consolidated Min. Co., Eureka, Utah. |
| Crocker, A. L. | 601 North West Bank Bldg., Minneapolis, Minn. |

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DAVIES, R. G.....2524 Hilgard Ave., Berkeley, Cal.
FERNAU, J. J. C., Hertion Wharf Works, Alferton, Wombley, London, England.
FLETCHER, F. M.....Independence Min. Co., Phelan, Tex.
FRISBIE, HOWARD I.....Race Track, Mont.
GRAY, T. E., Student, Colorado School of Mines, Golden, Colo.
GRUBB, EVERETT L.....620 N. Lake St., Madison, Wis.
HART, RAY W.....1112 E. 9th St., Tucson, Ariz.
HATFIELD, PERCY W., 3312 Woolworth Bldg., New York, N. Y.
HILL, BENJAMIN F....302 N. 4th St., Cripple Creek, Colo.
HINDSHAW, H. H.....617 Forest Ave., Ann Arbor, Mich.
HOGNASON, GUY B.....Phoenix, Ariz.
HURD, HAROLD W., 400 W. Capitol Ave., Springfield, Ill.
HUTCHINSON, RANDOLPH B., 703 Central Bldg., Los Angeles, Cal.
JONES, ALLAN BROWN, 1522 Lafayette St., Denver, Colo.
LAWRENCE, WILLIS.....Mammoth Mines, Mesa, Ariz.
LI, CHU.....Student, Columbia Univ., New York, N. Y.
LIDVALL, EDWARD ROBERT, 159 Pierpont Ave., Salt Lake City, Utah.
LYON, JOHN F., 508 Pacific Finance Bldg., Los Angeles, Cal.
LYONS, CLYDE FRANCIS.....Box 18, Tyrone, N. M.
MCDONALD, JOHN A., 322 Federal Bldg., Salt Lake City, Utah.
MCKENNA, J. P.....Wall Street, Boulder Co., Colo.
MCVEY, EARLE YANCEY, Genl. Supt., Mine Office, Coal Beth Coal Co., Bentree, W. Va.
MAILHOT, CHARLES, C. M. Fassett Co., 209 Wall St., Spokane, Wash.
MARCH, HARRY, Councillor, Midland Institute of Min. Engrs., 17 Victoria St., Westminster, London, S. W., England.
MARSH, LESTER C....1319 Van Horn Road, Independence, Mo.
MILLS, FRANK S.....Province Lake, N. H.
MORGAN, D. M.....407 W. 4th St., Joplin, Mo.
NIEMAN, HENRY W.....27 West 44th St., New York, N. Y.
NUGENT, WILLIAM E., Colorado School of Mines, Golden, Colo.
OLSON, VAN CLEAVE A.....Park City, Utah.
O'NEAL, FRANK E., Gouleg Mountain Coal Co., Jodie, W. Va.
PERKINS, H. C., 1701 Connecticut Ave., Washington, D. C.
PONTON, G. M.....Westbrook Hotel, Fort Worth, Tex.
ROBERTSON, FITCH.....Box 326, Metcalf, Ariz.
RODGERS, GEORGE B.....30 E. 21 St., New York, N. Y.
SANDS, W. E.....209 Ocean Front Ave., Venice, Cal.
SCHULER, HERMAN, Director, Agna Amarga Copper Co., Ltd., Vallenar, Chile, South America.
SHAYES, FRED P., Roxana Petroleum Corpn., Covington, Okla.
SHERIDAN, L. M., International Nickel Co., Copper Cliff, Ont., Canada.
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SMITH, GEORGE, Dept. of Mines, Sydney, N. S. W., Australia.
STARR, CHARLES C., Supt., Tonopah Divide Mine, Tonopah, Nev.
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THOMAS, BRET HARTE, Compania Minera de Penoles, S. A., Mapimi, Estado de Durango, Mexico.
THOMAS, W. E., Cia Minerales y Metales, S. A., Apt. 251, Monterrey, N. L., Mexico.
THORPE, O. E.....Sheep Ranch Mine, Sheep Ranch, Cal.
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TSENG, YIN LIAN.....Blinjoe Banka, Dutch East Indies.
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TURNER, ALBERT A.....Box 517, Iowa Park, Tex.
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WARD, R. J., British Burma Pet. Co., Yenang, Young, Upper Burma.
WATTS, BLYTHE D., Sec., Lynite Laboratories, Cleveland, O.
WESTERVELT, E. W., New England Oil Corpn., Maracaibo, Venezuela, S. A.
WILTSEE, E. A....Pacific Union Club, San Francisco, Cal.
WONG, YIN CHARLES, 414 W. 118th St., New York, N. Y.
WOO, Y. D., 521 Tompkins Hall, Columbia Univ., New York, N. Y.
YOUTZ, RALPH C., Calumet & Arizona Min. Co., Bisbee, Ariz.
YUAN, P. L., Care Mr. T. L. Yuan, Livingston Hall, Columbia Univ., New York, N. Y.
ZIEGLER, VICTOR, Colorado School of Mines, Golden, Colo.

# Engineering Societies Library

HARRISON W. CRAVER, Director

The Engineering Societies Library, on the 13th floor of the Engineering Societies Building, 29 West 39th St., New York, contains approximately 150,000 volumes of engineering literature. It is open on week days, excepting holidays, from 9 a.m. to 10 p.m.

The Library offers, on payment for the extra work required, to supply photoprints or translations of articles, make searches for information, prepare lists of references and suggest books on engineering subjects. The cost of searching is $2 an hour. Translations cost $6 and upwards per thousand words. Typewritten copies, $1 a thousand words. Photoprints, 11 by 14 in., cost $0.25.

When the Library contains two copies of a book, one may be borrowed by a member. Transportation costs must be paid by the borrower.

The Library is at the service of every member. Those who cannot visit it may order searches, translations, copies, etc., by mail.

Address correspondence to the Director of the Library, Harrison W. Craver, 29 West 39th St., New York.

**Coal Mining Costs.** By A. T. Shurick. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 515 pp., diagrs., tables, 6 × 9 in., cloth, $5.

This is the first book on coal-mining costs. The author has restricted his inquiry to underground costs, covering mining, shaft sinking, haulage, timbering and various miscellaneous items. The treatment has been made as thorough and specific as possible. By giving the date when each piece of work was done and including a table showing all the wage scales in the Central Competitive District since 1898, it has been made a simple matter to estimate the cost in terms of present wage scales.

**Coal Manual for Salesmen, Buyers and Users.** By F. R. Wadleigh. Cincinnati, O., National Coal Mining News, 1921. 184 pp., 5 × 6 in., cloth, $2.50.

A book of pocket size intended to give accurate elementary knowledge regarding the origin, structure, chemistry and uses of coal, for salesmen and users of coal who wish information on methods of purchasing, transporting and testing coal and coke, on the requirements of various users, and on proper methods of using fuel.

**Cours de Mécanique Appliquée.** By Marcel Lamotte. Paris, Gauthier-Villars et Cie, 1922. 282 pp., diagrs., 6 × 10 in., paper. 25 fr.

The author feels that most textbooks of applied mechanics require more extensive knowledge than the usual student possesses and are unnecessarily difficult. He has prepared this book, not to replace the more elaborate treatises on the subject, but to prepare the student for them, and has presented, in the simplest form possible, some of the questions that affect the applications of mechanics. He is less concerned in establishing general theories than in showing, by examples, how practical problems may be solved.

**Cyaniding Gold and Silver Ores.** By H. Forbes Julian and Edgar Smart. Third edition, revised and enlarged. Lond., Charles Griffin and Co., Ltd.; Phila., J. B. Lippincott Co., 1921. 417 pp., diagrs., tables, 6 × 9 in., cloth, $12.50.

The second edition of this well-known treatise appeared in 1907. Work on the present edition began in 1914, was interrupted by the death of Mr. Smart and by the war, but was finally completed by A. W. Allen.

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Much new material dealing with recent modifications in the theory and operation has been added and the chapters have been rearranged to secure greater uniformity. The principal additions are in connection with colloidity and adsorption; the theory of gold precipitation on charcoal; milling in cyanide solution, flotation and cyanidation; zinc-box practice; deoxidising solutions; counter-current decantation; aluminium, sodium sulfide and charcoal precipitation; agitation, slime-settlement and filtration equipment.

**Determination of Sulfur in Iron and Steel;** with a Bibliography, 1797–1920. By H. B. Pulsifer. Easton, Pa., Chemical Publishing Co., 1922. 160 pp., illus., 6 × 9 in., cloth. $2.50.

This book is a review of present knowledge concerning the sulfides that occur in iron and steel, the methods of analysis, the results obtained with them and the precision of these results. It is intended to provide a basis for research. The bibliography covers the literature from the beginnings of wet analytical chemistry and is fully annotated.

**Dictionary of Applied Chemistry.** By Sir Edward Thorpe. Vol. 3. Revised and enlarged edition. N. Y., Longmans, Green and Co., 1922. 735 pp., illus., 6 × 9 in., cloth, $20.

This volume contains an important article, 98 pages long, on explosives, by G. H. Perry; others are on glass by W. E. S. Turner; on water-gas, by Alwyne Meade; on iron by Thomas Turner; on fuel by Dr. William A. Bone; on fermentation by Dr. Arthur Harden; fire extinction and prevention, and on air gas and oil gas, by Vivian B. Lewes; a number of articles on oils, fats and waxes, by Dr. Julius Lewkowitch.

**Dictionary of Applied Physics.** Vol. 1. Edited by Sir Richard Glazebrook. Lond., Macmillan and Co., Ltd., 1922. 1067 pp., illus., diagrs., 6 × 9 in., cloth, $15.

The first volume of an important work of reference in which will be summarized the present state of our knowledge of physics as applied to matters of engineering and manufacturing. Each volume will cover one branch of the science and be practically complete within itself. In preparing the book, Sir Richard Glazebrook has had the help of many of the leading physicists, who have contributed articles on their specialties. The work will consist of five volumes.

The present volume covers mechanics, engineering and heat. It contains extensive reviews on steam and internal combustion engines, hydraulics, calorimetry and thermometry lubrication, determination of elastic constants, thermodynamics, friction, steam turbines, ship resistance, strength of structures and dynamometers. Bibliographies are given.

**Fluidity and Plasticity.** By Eugene C. Bingham. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 440 pp., tables, diagrs., 6 × 8 in., cloth, $4.

A careful study of our knowledge concerning the flow of gases, liquids and solids, and of the theories that have been advanced by different investigators. Part one discusses viscometry and the viscometer. Part two treats of viscosity, fluidity and plasticity, and includes chapters on lubrication and on further applications of the viscometric method. The author offers a theory of flow in general, the first to be published. An extensive bibliography is included.

**Isotopes.** By F. W. Aston. Lond., Edward Arnold & Co., 1922. 152 pp., plates, diagrs., 6 × 9 in., cloth, $3. (Gift of Longmans, Green & Co.)

An exact account of the discovery of isotopes, of the methods used to detect them and of present theories in explanation of them. Particular attention is paid to the author's mass-spectrograph and the work done with it on various elements.

**Papers on Current Transformers.** By H. W. Price and C. Kent Duff. University of Toronto Press, 1921. (University of Toronto School of Engineering Research. Bulletin No. 2, Section No. 4.) 65 pp., illus., diagrs., 6 × 9 in. Free.

The five papers in this bulletin are the electrical studies for the year 1921 at the University of Toronto School of Engineering Research. They have to do with investigations of the effects of magnetic leakage, a method of measuring ratio and phase angle, through-type portable transformers and with minimising errors by mean of shunts. In view of present interest in the design of current transformers, these papers will be of value to designers. Little is available in print on the subjects here discussed.

**Steam Power Plant Auxiliaries and Accessories.** Terrell Croft, editor. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 447 pp., diagrs., illus., 6 × 8 in., cloth, $3.

Data to assist the power plant engineer in selecting auxiliary equipment and in installing, operating and maintaining it so that preventable losses will be kept as low as possible and power will be generated at the least cost. The treatment is simple, non-mathematical and descriptive.

**Steel Foundry.** By John Howe Hall. Second edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 334 pp., illus., diagrs., tables, 6 × 9 in., cloth, $4.

The author's object has been to set forth the metallurgy of the steel foundry from the point of view of the engineer interested in prescribing the cheapest means of producing objects of sufficient excellence for the purposes for which they are intended. His book considers the classes of steel castings in demand today and their characteristics from a manufacturing point of view; the types of steel-making processes in use and their characteristics that govern the selection of one or another for making the sort of castings desired; and shop procedure in the light of its influence on quality and cost.

The revision has introduced new data on electric furnace practice, on molding sands, heat treatment and other phases of foundry practice.

**Thermal Stresses in Chilled Iron Car Wheels.** By G. K. Burgess and R. W. Woodward. Wash., Government Printing Office, 1922. (Technologic papers of the Bureau of Standards, No. 209.) 34 pp., plates, diagrs., 7 × 10 in., paper, $0.05.

Describes a method for testing car wheels under conditions nearly like those encountered in descending long grades, and gives the results obtained from a series of tests. Twenty-eight wheels of varying weight and design were tested, sixteen of which cracked in the plate. The tests suggest the possibility of improving the design of these wheels.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

Positions of the Bureau are on file in the office of the Engineering Societies Employment Service Bureau and with secretaries of A. I. M. E. local sections.

## Engineers Available

**Mining Engineer.**—Technical graduate. Four years varied engineering experience in Western mines. Last three years instructor in engineering college. Prefers situation leading to responsible executive position with mining company or one with firm of consulting engineers. IM–1606.

**Manager or Superintendent.**—Graduate. Eleven years mine and mill operation in western United States. Efficient executive. Married. Age 34. IM–1607.

**Mining Engineer.**—Design and construction of coal tipples; power plants and general machinery; surveying mapping and general coal-mine development. Experienced draftsman. IM–1608.

**Mechanical Engineer.**—Graduate. Twenty years chief draftsman on mine, mill, smelter buildings and machinery. IM–1609.

**Engineer or Superintendent.**—Lifetime experience in coal mining. Eight years in charge construction and operation of mines and washeries. Good record for production, costs and handling men. Age 32. Married. IM–1610.

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**Metallurgical Engineer.**—Broad experience in heat treatment of iron and steel, also ferrous and non-ferrous alloys. Successful research record. Business experience. IM–1611.

**Chief Engineer or Assistant Superintendent.**—Ten years in coal and iron mines. IM–1612.

**Superintendent.**—Mining and milling, metallics and non-metallics, surface and underground. Seventeen years experience. IM–1613.

**Mining Engineer.**—20 years experience in United States and Latin-America as engineer, superintendent, and manager Construction, operation and development. Fluent Spanish. IM–1614.

## Positions Open

**Young Man** to supervise grinding of manganese castings. Must have had this experience. Ohio. V–258.

**Mill Superintendent.**—Ore is complex, having zinc, arsenopyrite, and antimony. Tests are about to be made for determining treatment to be used in a test mill. Possible that concentration, cyanidation, and flotation may all come in. Location near Cuba; desirable living conditions. Ability to speak Spanish desirable but not required. Practical and up-to-date man wanted. Apply by letter. V–1111.

**Structural Engineers** for structural steel and reinforced concrete design, including all types of buildings, from power houses to office buildings and churches. Apply by letter, stating experience, salary requirements, earliest reporting date, and submitting some recent work. Michigan. V–1152.

**Graduate Mining Engineer.**—Experienced in railroad location work, open-cut mining and mapping. Apply by letter. South America. V–1157.

**Mining Engineer** with field experience along mining, ore-dressing and metallurgical lines, particularly non-ferrous metals. Should have attained a position occasioning dealing with men of different classes, as well as business propositions outside of ordinary routine details. Would teach two hours per week of elementary geology, and probably a like number of hours along engineering lines. Beyond this, work would lie in assisting head of school in organizing and administering curriculum, and in establishing contacts throughout the state. Apply by letter. Middle West. V–1202.

**Sales Engineers** for New York, Pittsburgh and Detroit. New men will spend from one to three months in the shop as ordinary workmen doing work that will be of value to them as salesmen, then will be put in the field on actual erection of product for a similar period, and will stay in Cleveland office long enough to become familiar with forms and general policies. Opportunity to qualify for position of district manager. Apply by letter. V–1229.

**Mine Foreman.**—Several years experience. South America. Apply by letter. V–1346.

**Engineer** to act as superintendent in a small factory. Must have good personality and know something about steel, particularly cold rolled and drawn processes. Age 35 to 40. Apply by letter. Michigan. V–1350.

**Engineer** to handle sale of mechanical stokers. Must have some knowledge of combustion and boiler room practice. Give particulars of education, experience, etc. Apply by letter. Headquarters, New York City. V–1352.

**Technical Graduate** who has had a few years experience, for drafting and field work on hydraulic power-house extensions, substation and transmission line designs and construction. Apply by letter, stating age, whether married or single, experience, education, and amount of salary expected. Pennsylvania. V–1382.

**Sales Engineer** (2) for manufacturer of carbon products, to trade using or manufacturing electrical equipment. Technical graduates, 28 to 35 years of age. Selling experience in electrical lines desirable. Apply by letter. Ohio. V–1389.

**Physicist or Electrical Engineers** (2) for development and engineering work on vacuum and gas-filled electrical devices. Post-graduate degree desirable. New York City. V–1390.

**Analytical Chemist.**—Recent graduate. Apply by letter. New York City. V–1421.

**Research Chemist,** experienced. Apply by letter. New York City. V–1422.

**Draftsman** acquainted with general bituminous mine drafting. Prefer single man. Experience with bituminous operating company essential. Apply by letter. West Virginia. V–1438.

**Young Engineers** (2) to learn the business of screw manufacturing. Men with scientific education and at least a year's work in some business. Willing to do hard work, with a natural aptitude for mechanical work and a capacity for remembering an immense amount of detail. Apply by letter. Pennsylvania. V–1461.

**Engineer** to teach subject of internal combustion engines. If possible, with some teaching experience, supplemented by a considerable amount of practical experience. Work would consist of instruction in high-speed gasoline engine, tractor engine and heavy oil engines of the Diesel and Semi-Diesel Type. Full professor. Apply by letter. Outside consulting practice possible if not allowed to interfere with college work. Middle West. V–1464.

**Plant Engineer** for large copper refinery on Eastern seaboard to take charge of maintenance and design of power house, crane service, charging and casting apparatus, transportation and handling of large tonnages. Experience in metallurgical plant, executive abilty and common sense, with adaptability to learn business. Age 30 to 40 years. Apply by letter giving education, experience, present location, salary expected, how soon available and references. Maryland. V–1471.

**Mechanical Engineer** with combustion and sales experience, to handle oil-burning equipment for power houses. About 28 years old. Apply by letter. New York City. V–1512.

**Office Manager.**—Business of company is manufacturing concrete stone and ornamental ware, also construction of buildings. Want first class man able to handle routing correspondence as well as keep accounts, available immediately. Apply by letter. North Carolina. V–1514.

**Reinforced Concrete Designer and Draftsman,** man who has had considerable experience along the line of reinforced concrete office buildings, warehouses, etc., one who has been trained technically along this line and has had considerable drafting room experience. Apply by letter. Texas. V–1516.

**Engineer** to take charge of a field party on general property surveys. Must be a man of experience and good judgment on this class of work, and an accurate map computer and draftsman. Apply by letter. New York. V–1533.

**Young Man** with knowledge of chemistry and some experience in pulp and paper manufacturing, for investigative work. Apply by letter. V–1541.

**Engineer** familiar with combustion of powdered coal, particularly for metallurgical processes. Capable of handling labor and of taking charge of operation of furnaces producing malleable iron castings. Apply by letter. Michigan. V–1545.

**Maintenance Engineer** with chemical plant experience, preferably dye plant, able to design and equip additions to plant. Graduate engineer. Should have had G. E. or Westinghouse test course. Apply by letter. New Jersey. V–1562.

**Recent Graduate** for cost work, mechanical engineer preferred. New York City. V–1584.

**Professors, Assistant Professors, Instructors** of technical and engineering subjects, wanted immediately for colleges and universities. Write fully; no advance charges. Educators' Department, H. H. Harrison & Co., Employment Service, 19 S. La Salle St., Chicago, Ill. *Paid Agency.* V–1585.

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# Industrial News and Developments

**Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinised but not vouched for by the Institute.**

## Manufacture of Safety Fuse

FEW, if any, authentic accounts of the manufacture of fuse have been published previous to the following, which is given out by the Hercules Powder Co., at Wilmington, Delaware.

The article quoted is by Messrs. Ellsworth and Brandon of the Ensign-Bickford Co., and was published in the *Hercules Mixer.*

The first process in the manufacture of fuse is practically the same on all grades of fuse, and consists of spinning or winding jute or cotton thread about the powder core and centerthread. Powder is fed to the spinning machine by gravity from special powder chambers in the room above. The centerthread constantly moves through the column of powder, drawing it down through special powder-feeding device which regulates the flow to a definite quantity per foot of fuse. The jute yarn is wrapped about the powder at a sufficient tension so that any voids are immediately closed or any reduction in the powder flow is evidenced by a reduction in the diameter of the fuse.

Immediately after the powder is encased in the spinning threads, there follows, in the same operation a countering process which consists in a counter winding of yarn, also under tension, to hold the fuse together. The fuse at this stage consists of the powder core, centerthread, spinning threads, and countering threads, and is wound on spools which become the unit of manufacture.

From the spinning room the fuse goes to the inspection department where it is handled by experts. It passes through mechanical inspectors, delicate in operation and automatic in detection. The chief purpose of this is to eliminate imperfections in the powder core. After leaving this department, the fuse is immediately coated with a waterproof compound which forms a groundwork for subsequent waterproof coatings. From this point on, the process is varied according to the type of fuse. Broadly, fuse is of two classes: the tape finished and the countered.

Considering the tape varieties: The next process is that of applying a waterproof compound and, over it, a protecting cloth tape. The success of a fuse to be used in wet work depends to a very large extent on the character of the waterproofing compounds used in the taping department, for not only must the product be waterproof under normal conditions, but it must, as far as practicable, be insusceptible to temperature changes. Insusceptibility to wide temperature changes is limited by the necessity of obtaining a waterproof coat of sufficient body to insure stability and waterproof values without danger of injuring either the powder core beneath or the exterior finish. Fuse manufacturers, therefore, urge, as printed on the fuse wrappers (and this applies especially to tape fuse), that in cold weather fuse should be warmed slightly before uncoiling in order to prevent cracking, which injures its water-resisting qualities. Single tape, double tape, and triple tape are substantially alike except in the number of applications of waterproof compounds and tape. Each successive tape is wound on the fuse in the opposite direction to the one preceding it so as to produce a firm effect and give uniform strength to withstand bending in any direction; and over each tape is applied, under pressure, a waterproof compound which thoroughly saturates it. When the fuse comes from the taping department it is transferred to the finishing department where it receives another coat of waterproof compound and immediately afterward a thin white finishing varnish, the principal constituent of which is china clay.

It should be noted that the requirement for good waterproofing is a black, soft, flexible, waterproofing coat both under and over the tapes and that this material must be covered with only a thin white varnish, the purpose of which is not only to make an attractive finish but to keep the fuse from becoming sticky in warm weather.

A characteristic of the tape finished varieties is a tendency to discoloration in ageing. Usually this is caused by absorption due to the nature of the waterproof coatings underneath, and occurs more readily in hot climates or under hot storage conditions. In ordinary cases, however, this discoloration, or absorption, does not in the least affect the quality of the fuse except as to external appearance.

## American-made Drawing Instruments

THE C. F. Pease Co., North Franklin St., Chicago, Ill., has just printed a catalog illustrating and describing high-grade American-made drawing instruments manufactured by the company in its Chicago factory.

## Trade Catalogs

**Adam Hilger, Ltd.,** 75A Camden Road, London, N. W. 1, England.—Leaflet describing the Chemical Spectrometer, for use in chemical analysis.

**Combustion Engineering Corpn.,** Broad St., New York City.—Booklet on powdered-coal installation at River Rouge plant of Ford Motor Co. While largely a reprint of the previous Ford booklet, it contains also some interesting information on operating results at this plant.

**Joy Mfg. Co.,** Union Arcade Bldg., Pittsburgh, Pa.—Leaflets on Joy Coal Digging and Loading Machine.

Bulletin 9, on Self-feeding Portable Loader, Type 4-A.

**Sullivan Machinery Co.,** 122 South Michigan Ave., Chicago, Ill.—Specification sheet for Angle Compound Steam Driven Air Compressor, Class "WD," direct flow type.

The steam end of the compressor consists of a four-valve cylinder, with the element of initial condensation reduced to a very low factor by the arrangement of the inlet and discharge valves, which provide for the flow of the steam from inlet to exhaust in a direct path, and for high compression.

Bulletins 79-C, D, E, and F. Sullivan Ironclad Coal Cutters and Equipment.

Bulletin 77-D. Portable Air Compressors (three types) and hammer drills.

Bulletin 70-X. Sullivan Pneumatic Spader or Clay Digger.

**Denver Rock Drill Mfg. Co.,** Denver, Colo.—Booklet on Waugh-Sinclair Portable Air Compressor. Description and general specifications of plant.

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Mining and Metallurgy, July, 1922, No. 187—Section Two

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**29 West 39th Street**
**NEW YORK**

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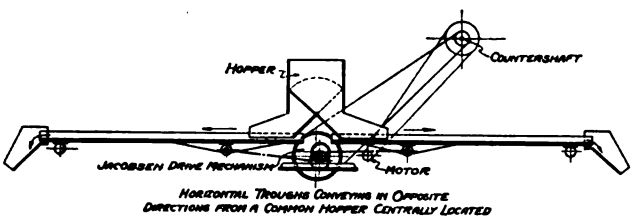

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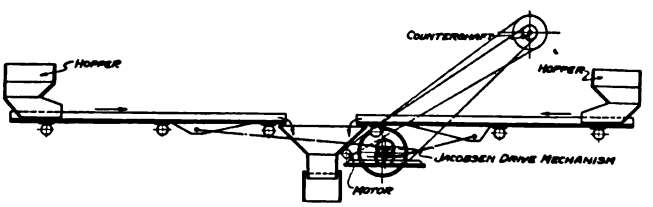

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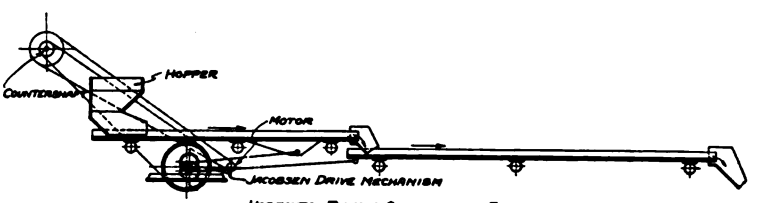

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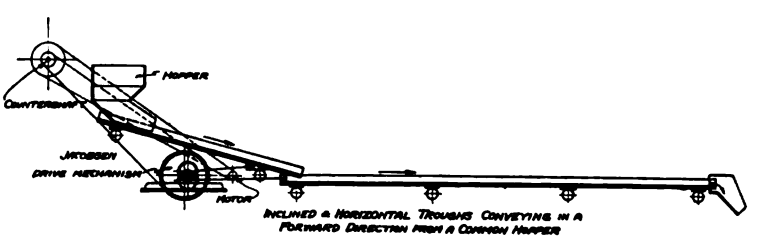

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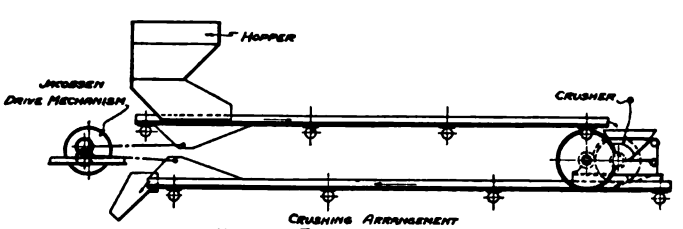

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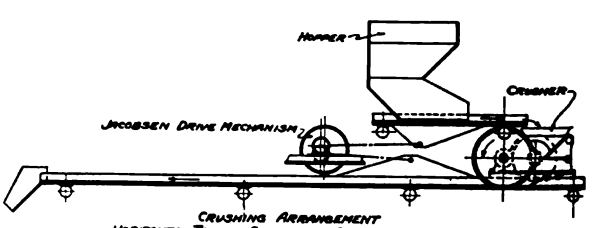

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# MINING AND METALLURGY

THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
29 West 39th Street, New York City, N.Y.

No. 188 AUGUST 1922


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FREDERICK F. SHARPLESS, Editor.
PERCY E. BARBOUR, Managing Editor.



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## EDITORIAL

### The Underlying Issue of the Strikes

THE issue that now confronts the American people in the form of the coal and railway strikes, particularly the former, is of the nature of a crisis, that is far deeper in its meaning than is commonly supposed. There is danger that politicians who want always to carry water on both shoulders and that timid citizens who are anxious to avoid immediate troubles, even at the risk of worse to come, will aid and abet in a present composition that will entrain much more serious consequences. The talk among members of Congress about taking a hand is ominous. I have read no statements by those representatives of the people that have evinced any understanding of the real issue that now confronts us all.

In such a juncture as the present, the distracted thought seeks peace under two heads: (1) Arbitration; if these warring factors can not arrange their difficulties, while the public is suffering, then drat upon both their houses, and arbitrate for them; (2) Arbitration and investigations, meaning to compose things temporarily by means of an impartial agency and follow with a study of the industry, that admittedly functions badly, so as to get it on a sound basis and avoid future troubles. Either of these programs, but particularly the latter, sounds reasonable.

But, in truth, there is nothing to arbitrate and nothing to investigate. There is no arbitration when the bandit has his victim by the throat. As for investigation, we know that the bituminous mining industry is over developed, and overmanned. We know that the excess of mines must be extinguished and that the surplus of miners must be transferred to other industries. A commission may add some details to the knowledge of this situation, but its general outlines are already clear enough.

The clear-headed will keep these conditions in view. In 1919 and 1920 the national income attained a maximum of about 66 billion dollars and labor as a whole



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obtained a supernormal share thereof. Indeed, the share appropriated by it was undoubtedly the maximum possible and probably was more than could be retained by it with economic safety for the nation. Out of this increase and unhealthy share, the coal miners and railway men obtained their full proportion. The concrete expression of this was a wage scale and an annual rate of earnings higher than ever before.

There is no statement of the present rate of national income, but we know that it is much lower than in 1920, for employment is less while prices are lower, the latter being about three-fourths what they were. Consequently, the physical volume of production is less than what it was in 1920 and the value of the unit of production is lower. If we estimate the present rate of national income at two-thirds of the maximum, as expressed in dollars, probably we shall not be far wrong. Therefore, what the coal miners and railway workers in resisting readjustment are trying to do is not merely to retain their war-time proportions of the national income but rather is it to keep their war-time aggregate while other people are averaging only two-thirds as much. Manifestly, if these men are to take the same slice out of two-thirds that they used to get out of three thirds of the people will have to get along with smaller slices. This is the bald economic principle that underlies the present contest.

Collateral subjects that are introduced in order to becloud the issue and muddle brains, may be brushed away. If the bituminous coal miners see fit to subdivide their slice among more men than are needful, that is no just claim for a larger slice. Nor can they get any more part of the slice that is marked for property and management, for it has already been pared dangerously small. The simple fact is that the increased slice of the national income that these classes of workers are seeking for themselves can only be secured at the expense of all other workers—the farmers non-unionized town-workers and even their fellow unionists. The immediate consequences of this strike are going to be felt acutely by the factory workers everywhere. The hand of every man would be against these strikers if every one understood the conditions of his own welfare.

That the American Federation of Labor itself is not reviling the striking coal miners and railway shop men is ascribable to one of only two things, *viz.*, organized labor does not understand whither its policy is leading, or else it is deliberately pursuing the plan of capturing an undue share of the national produce at the expense of all other workers, a policy to which the other branches of the general union assent, in spite of an immediate prospect of suffering, in the expectation that the aggrandizement of their class as a whole will speedily follow.

This thought changes consideration of the subject from the field of economics to that of politics. As between the alternatives of ignorance and intelligence on the part of the leaders of organized labor, we are bound to give them credit for the latter. In doing so, however, we can not escape the conclusion that they are aiming to create a form of Soviet government within the United States, *i.e.*, a régime under which a relatively small class of workers, specifically about 10 per cent. of the whole number, will undertake to dictate the legislation that they will have in their own interest, the conditions under which they will produce and the share of the total produce that must accrue to them; and will let all the rest of the workers go hang.

Already the United States has taken the first step in this direction through the enactment of the infamous Adamson law, which enabled the railway workers to take the nation and its industries by the throat. The coal miners are now aiming to push weakminded politicians into making the second step. If that be taken we shall have gone a long way, for the builders by their local rules, exactions and limitations against competition have already put themselves in a strong position.

The Soviet system in Russia failed for the reason that its promoters, in their guileless simplicity following the fallacies of Karl Marx, did not understand that the workers of a country can not accomplish much, or even earn a decent living, without the guidance of brains; and they drove the intelligentsia out of Russia. The leaders of union labor in America are wiser and aim to retain the brains of management just as heretofore and to keep them working as hard as ever (or harder), but otherwise to have things in their own way and in general to promote the welfare of their class at the expense of everybody else, which would mean especially at the expense of the farmers and the unorganized town-workers.

The foundation upon which this policy is erected is simple terrorism. Unionized labor contemplates the consummation of its plans by grasping the control of the work in essential industries—transportation, fuel supply, etc.—and saying to the people of the country that they may have food and fuel only upon the terms that the unions grant, and that if there be any attempt to employ other men who are willing to do the work they will be maimed or killed. This disgraceful program could never have been carried so far if we had not had too generally weak men in our governments—federal, state and municipal—who were anxious to talk arbitration and conciliation whenever organized labor has snarled; and if there had not been so many misguided sentimentalists, conducting church movements and literary propaganda in behalf of the "underman," which was playing right into the hands of organized labor, ever pursuing its malign purpose. Fault may be found, too, with business men who have promoted false ideas about prosperity, which may even have deceived the labor leaders themselves.

I write these lines a long time before they can be published, and I do not venture to prophesy what is going to happen during the next three weeks. There

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may be a crisis of violence requiring the display, and maybe use, of strong military force; and there may be a political composition that will tide things over and give us the appearance of peace for a few years. If the latter be the result, the arrangement will be but temporary and the issue will crop up again. We are dealing today with forces that are shaking our economic, political and social structure to its foundation, and most people do not know it. The alternatives are clear cut. On the one hand there is the establishment of class control; and on the other hand the reaffirmation of the old American principle of the freedom of everybody to work.

W. R. INGALLS.

## The Coal Strike

AS I prophesied a long time ago, 1922 is being a year of widespread and extensive labor troubles. During July it was estimated that about 1,250,000 men were on strike. Practically all of these were in the ranks of unionized labor. Considering that the present membership of the American Federation of Labor is about 4,000,000, and considering that the total number of factory workers, miners, builders and transportation men is about 15,000,000, we are able to size up the situation better than if it be considered in merely a general way.

The result of the coal strike, which began with April 1, became acute, as everyone knew must be, although the development was rather slow, owing largely to the sub-normal demand for coal. However, it was impossible for the non-union mines to produce all that was needed, and the absence of any production of anthracite naturally excited alarm for the coming winter.

With these conditions, the Administration was obviously bound to take a hand in the interest of the general public, which was proper. So the President proposed on July 10,

1. That the mine workers return to their labors on the basis of the wage scale existing March 31, when they quit.
2. That a coal commission be created at once composed of three members selected by the mine workers, three by the operators and five by the President; all decisions by this commission to be binding.
3. That the commission determine a new wage scale by Aug. 10 and that the previous scale prevail until a determination is reached.
4. The commission to make an exhaustive investigation of the industry, examine into profits, and make recommendations for stabilization, avoidance of intermittency of employment and other evils.

This program created something like consternation among people who try to look below the surface of things. The union miners in the bituminous fields (or such of them as are needed) presumably stood ready to go back to work at $7.50 per day. Such a *dénouement* would have been a victory for them. The crying need of industry for cheaper coal would have gone unappeased, for we all know what kind of a compromise any political commission would have made. The thing has not been made quite clear, but it appears that the proposed settlement was intended to apply to the non-union mines as well as the union, which looked rather preposterous.

However, the country escaped a great danger by the skin of its teeth, in that the United Mine Workers refused the President's proposal, whereupon a majority of the operators, perhaps for tactical position, accepted it. There remained then nothing for the President to do but to send the operators back to their mines with the word to reopen them and the intimation of Federal protection, which the governors of the coal mining states were subsequently asked to give in the first place.

Right from the beginning there had been a quick and effective way to restore the production of coal to the necessary rate. This was for the Government—federal, state, county and municipal—to insure protection to the operators who wanted to keep their mines open and the miners who wanted to work in them. The surreptitious drift of union miners to the non-union fields showed that there were miners who wanted to work, and Governor Allen in Kansas has shown what might be done by an effective and impartial establishment of the right of everybody to work without running the risk of being murdered. The intervention of the Administration in this direction would have been more effective if it had been earlier.

Without any doubt there is going to be a shortage of coal this winter. Even if the mines should be reopened generally and worked intensively it is doubtful whether the railways have adequate capacity to carry within a few months what will be needed. It is probable that the Government will have to take a hand in the rationing of coal supplies. In that event, it is to be hoped that the labor leaders and union miners will be short of fuel like other people. This would be a salutary object lesson of the economic principle that people can divide only what they produce.

W. R. INGALLS.

## The Living Wage

AS illustrative of political ideas for the settlement of present labor difficulties, there may be mentioned the plan that is ascribed to Judge (formerly Senator) Kenyon of Iowa. His plan contemplates the creation of a national coal mine board, for which the guiding principles are to be the declarations "(1) that coal is a public necessity; (2) that the public interest is predominant in its production and distribution; (3) that every unskilled or common laborer has a right to earn a living wage sufficient to maintain his family and to provide savings; (4) recognition of the right to collective bargaining; and (5) that the labor of children under 16 in the mines be prohibited."

This declaration comprises five points. Numbers 1 and 2 are trite and non-controversial, being equivalent

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to such assertions as "the people must eat," "murder is contrary to common welfare," "the Stars and Stripes is a good flag," etc. With respect to point No. 5 there will be no dissent. With respect to No. 3 every unskilled or common laborer undoubtedly has the right *to try* to earn a living wage, etc. Whether he can succeed in doing so depends upon himself in large measure, but fundamentally upon economic conditions. Millions of laborers, in India for example, can not succeed in doing so and no regulation of affairs by any board or commission would make it possible for them to do so. However, the important amendment to Senator Kenyon's principle rests in the words "to try." The labor unions deny to many common laborers the right to try to earn their living, reserving opportunities to themselves. The principle of collective bargaining may be conceded, with the qualification that it should not be permitted to become a means for organized labor to undertake to deprive the public of its necessities.

W. R. INGALLS.

## Engineering Congress in Rio de Janeiro

THE American Institute of Mining and Metallurgical Engineers has received a cordial invitation to send representatives to the Engineering Congress which is to be held in Rio de Janeiro during the coming winter. This invitation comes from the engineers of Brazil through official channels. It has been extended to the other national engineering societies, all of which will appoint, or have appointed, delegates. The dates for the sessions have not been definitely fixed but they will probably be held during the early days of the International Exposition which furnishes the background for this meeting.

This is the first occasion on which engineers of Brazil have extended such an invitation to American engineers, and it is perhaps because it is the first occasion that details of technical sessions and visits have not come to us in advance. American engineers who have just returned from Rio assure us, however, that the lack of a program does not mean lack of hospitality and an earnest desire to have American engineers participate in meetings. Hospitality, indeed, may take preference over technology, for hospitality speaks all languages while technology must be translated into Portuguese.

The Brazilian Government has for years been fully alive to the possibilities that lay in her undeveloped resources. She had the good judgment soon after she became a republic to call upon experienced American geologists to initiate a survey of her extensive territories. These men have done excellent work, leaving behind a deep respect for American geologists and mining engineers.

In the case of Brazil we have still another example of the flag following the pick of the prospector, but where the government had the good judgment to send the geologist in advance of the prospector, the development of mineral resources was placed on a firmer foundation and international trade has been developed on a more solid basis.

Brazil needs American capital and American engineers. American capital will some day need the undeveloped natural resources of Brazil and native Brazilians to develop them. The present seems an auspicious occasion for American engineers to meet the engineers of that country and to develop those cordial relations which her citizens are endeavoring to initiate. Brazil will not be the only gainer by such a conference; we may tell her engineers something of our progress and development in this country and the manner of its accomplishment, but while doing so we will be learning something of hospitality and those finer courtesies for which her people are so well known.

The Bureau of Mines is preparing an interesting exhibit which will be in charge of T. T. Read, who will sail for Rio about the middle of August. Mr. Read will also act as representative of the A. I. M. E.

It is hoped that members of the Institute whose business may call them to Brazil during the coming fall and winter will advise headquarters of their contemplated journey, so that suitable letters of introduction may be provided.

F. F. SHARPLESS.

## Too Much Coal

I HAVE read the excellent article on "Too Much Coal" by Mr. Peabody, which appears in this issue of MINING and METALLURGY. Mr. Peabody reveals the same ideas of *laissez faire* that I expressed in the May number. The gist of Mr. Peabody's views is contained in his last paragraph. There is only one point as to which I offer any dissent, and even that may be ascribable to oversight rather than to any difference of opinion.

The solution of this problem is to be found in free competition and the natural extinguishment of the unfit. I do not think, however, that this implies that we should do nothing. There are several things to be done, the most important of which is to establish freedom of the right to work. If that leads to disruption of the general industrial labor union, let that be. The Government may also properly assist in the transfer of superfluous coal miners from that industry to others. There were some other suggestions in my article in the May issue, but there were none that would conflict with the natural play of economic law.

W. R. INGALLS.

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# Review of the Month

JULY was a month of great turmoil, both economic and political, in many parts of the world. Instead of conditions improving, they seem to have been getting worse. In Ireland, civil war is still in progress. Germany was in the throes of a political upheaval. The meaning of the assassination of Rathenau became clear. It evinced the development of a class struggle between the bourgeois and socialistic parties which may rock the country to its foundation and will increase the difficulties of arranging things with the French and solving the reparations problem. In Poland, a similar contest is developing. Austria is already so completely contaminated by the socialist element that it is unable to get outside assistance and is thus falling into a state of despair but little short of what prevails in Russia.

The conference at the Hague came to an abortive end for the reason that it was impossible to discuss affairs with the Russians in any reasonable way.

The Germans declared their inability to meet the reparation payment that fell due on July 15 and the Commissioners for the Allies granted them an abatement of a portion thereof and are listening attentively to the supplication of the Germans for a moratorium of one or two years.

In the United States, July was a month of widespread labor troubles, accompanied by a great deal of disorder and violence, which led to detachments of the National Guard being called out in several states. The railway shopmen, about 400,000 in number, struck on July 1. The road maintenance men decided not to strike, but many thousands of them quit work without the sanction of their union. There were more strikes in the textile industry in New England and in similar industries all over the country. Early in July, it was estimated that about 1,250,000 men were out on strike.

The coal strike continued. Early in the month the President summoned operators and miners to Washington and submitted a plan for the compromising of disputes. After a week's consideration the miners refused flatly to agree to anything. The majority of the operators consented to accept the proposed arbitration, but a minority refused. Following this abortive attempt the President dismissed the conference with the injunction "to return to your mine properties and resume operation." Production has not increased.

Toward the end of July the storage of coal supplies began to produce very serious conditions, with the prospect that they would become worse. Consequently the government acted, through the Interstate Commerce Commission, assuming control of the distribution of coal through simplified routings, priority classifications, etc. The production of the non-union mines had previously been checked by shipping difficulties on account of the railway strike.

In American industry there was considerable relaxation during July, quite apart from the interferences imposed by the coal and railway strikes. The petroleum industry having accumulated excessively large stocks of crude found it necessary to reduce the prices in order to curtail production. Something like demoralization overtook the automobile tire industry also because of overproduction. Such conditions exemplify the danger of overdoing things. Also, they draw attention to the extent to which the recent spurt in activity has centered around the automobile manufacturing industry. There is no sensible person who believes that our national extravagance in automobiles can be maintained, although it must be granted that the car-making rate has not yet shown any statistical recession. On the other hand, the so-called building boom has clearly passed its zenith.

The consequences of the coal and railway strikes are bound to be profound. Large contracts for coal have been placed with Welsh and Scotch producers. The transportation of great quantities of coal from Great Britain hither is certain to upset easterly freight rates. Agriculturists in this country, producing fruits and other perishable products, are seeing them spoil on their hands out of inability to ship them. Industrial works are suspending operations. It is becoming generally recognized that all of these things are going to produce a slowing down of industrial activity. Such was in prospect anyhow by virtue of underlying economic conditions.

Among the metals, iron and steel continued strong, as would be expected from the troubles that the strikes are causing in this industry. Copper was rather dull, but the market maintained itself very well at 13 7/8 to 14c. Lead was strong during most of the month at 5.57c., New York, but toward the close became a shade easier. Zinc was the star performer, the price rising to 6c., St. Louis. For the moment zinc is in the best position of the non-ferrous metals, the demand for it in this country having increased substantially, while in other parts of the world production continues at a relatively low rate.

Successive reductions of the bank rate in Great Britain were viewed with a good deal of concern. They were interpreted as meaning that industry in Great Britain is still at a low ebb and has not yet experienced the improvement that has been hoped for.

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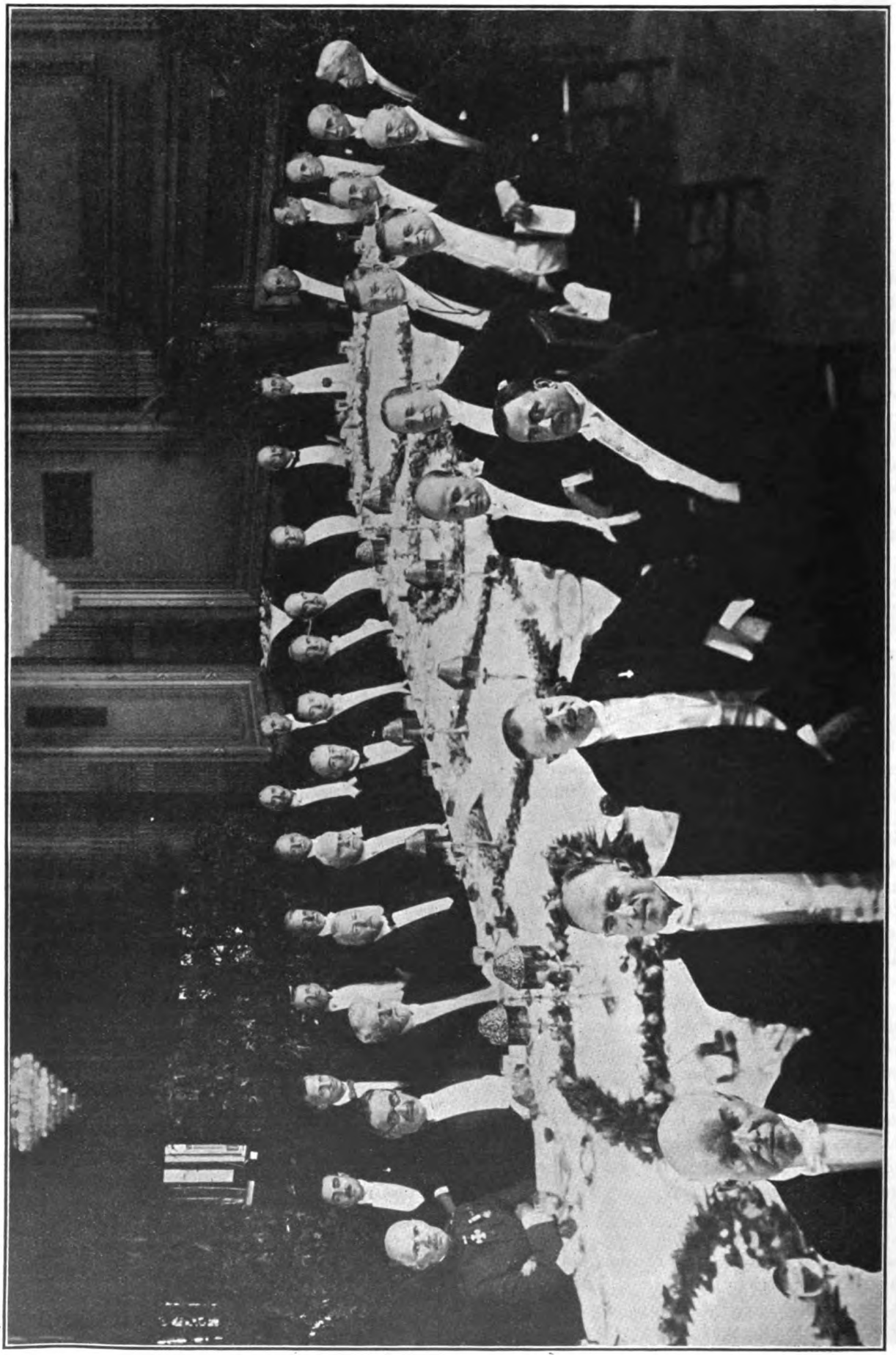

*Century Flashlight Photographers, Inc.*

DINNER TO SENATOR MARCONI, AT THE ENGINEERS' CLUB, NEW YORK, ON THE EVENING OF JULY 6, 1922

BEGINNING AT THE LOWER LEFT-HAND CORNER AND CONTINUING AROUND THE TABLE: E. J. NALLY, CALVIN W. RICE, JOHN W. LIEB, COMM. FRANCESCO QUATTRONE, COMFORT A. ADAMS, SENATOR MARCONI, ELIHU THOMSON, WILLIAM MCCLELLAN, J. WALDO SMITH, ORVILLE WRIGHT, ARTHUR S. DWIGHT, F. F. SHARPLESS, F. B. JEWETT, ROMONO ANGELONE, B. B. THAYER, J. VIPOND DAVIES, C. R. CORNING, E. M. CHANDLER, WALTER MCFARLAND, CALVERT TOWNLEY, DAVID SARNOFF, EDWARD D. ADAMS, GENERAL GEORGE W. GOETHALS, JAMES R. SHEFFIELD, AMBROSE SWASEY, MICHAEL I. PUPIN, MAJOR GENERAL G. O. SQUIER.

BACK ROW: DR. PAOLO ROSSI, ROBERT SIBLEY, F. S. CURTIS, HENRY B. SARGENT, FRED J. MILLER, CHARLES F. RAND, F. L. HUTCHINSON.

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# John Fritz Medal Presented to Senator Guglielmo Marconi

BEFORE an audience which included many notable members of the engineering profession, the John Fritz Medal was presented to Senator Guglielmo Marconi on July 6, 1922, in the auditorium of the Engineering Societies Building, in New York. The medal was awarded for achievements in the development of wireless telegraphy, but all of the speakers emphasized the inventor's service to mankind, in saving life at sea, especially, as well as his remarkable scientific attainments.

### Significance of the John Fritz Medal

The John Fritz Medal is presented from time to time for notable achievements in applied science, as a memorial to the engineer and metallurgist whose name it bears, one of the charter members of the American Institute of Mining and Metallurgical Engineers. The medal fund, contributed by friends of Mr. Fritz, is administered by representatives of the four national engineering societies. Seventeen awards have been made to men of eminent distinction in the various branches of the profession of engineering, whose names are more familiar to the civilized world than are the names of most of the presidents of the United States. Four of the medallists were present on the evening of July 6: Dr. Elihu Thomson, the dean of the electrical engineers, General Goethals, Orville Wright, and J. Waldo Smith, who developed the New York City water supply system.

In opening the meeting, Dr. Comfort A. Adams, president of the Board of Award, said in part:

The profession of engineering knows no national boundaries. That the engineers of this country sense this fact deeply is evidenced by the absence of any limitations as to nationality in the award of the John Fritz Medal.

The engineer is seeking for the truth wherever it may be found, and it frequently happens that the most helpful suggestions for the solution of a particular problem are the results of the work of men of other nationalities on the other side of the world, whom we have never seen. Thus through this long range interchange of information and of ideas, there has grown up a feeling of real kinship among the engineers of the civilized world, a sense of interdependence and of the need and value of coöperation, in wide contrast with the all too prevalent sense of conflicting interests, of racial and national antagonisms of bitterness and misunderstanding.

We often think of the nations of the earth as separated by walls or barriers, of various kinds and of various heights. Some of these are the natural results of evolution, for example, differences of language, customs and traditions; while others are more artificial, being maintained by law and dictated by fear, greed, and shortsightedness or ignorance.

There is deep conviction that the degree in which we can abolish these barriers is a true measure of our progress towards real civilization, and that the destruction of these barriers is the only method of attaining that world-wide peace for which every sane man cries out from the depths of his innermost consciousness, and which is so sadly needed by this warshaken thing that we call civilization.

But how can these barriers be removed? Some of the most fundamental of them can be and are being destroyed by the engineer and the scientist working hand in hand; for example, the barrier of distance. The present day facilities for transportation and communication would have been considered visionary even fifty years ago. These facilities are gradually eliminating distances and binding the ends of the earth together. They are bringing about a state of affairs where we can no longer be indifferent to the welfare of nations on the other side of the globe, where the closeness and interdependence of nations will be made so obvious to every thinking man, that helpful intelligent coöperation will be a necessity and war an impossibility. The brotherhood of man is a phrase much abused of late, but even this is bound to come as a necessity when distance has been annihilated.

These are some of the thoughts which have led us to attach peculiar significance to this occasion; not only because the engineering profession of the United States is honoring itself by awarding its symbol of highest recognition to the man who has done so much to abolish one of the greatest barriers which separate the nations of the earth, but also because he is an honored citizen of that nation whose decision on the side of righteousness and whose sacrifice in the cause of justice was such a large factor in terminating favorably the most frightful and destructive war in the history of mankind.

Thus it is that the engineers of America wish not only to do honor to a great Italian but also to acknowledge a debt of deepest gratitude to the courageous and illustrious nation which he represents.

James R. Sheffield, president of the Union League Club, for many years Marconi's legal adviser in the United States, spoke of the man himself, of his early life and education as well as of his later career. In speaking of the honors conferred upon him, Mr. Sheffield mentioned especially the recognition of his services accorded by the Italian Government in making him a senator for life.

### Greater Usefulness of Wireless Predicted

Prof. Michael I. Pupin, of Columbia University, himself an inventor of wireless improvements, dealt with the technical side of Senator Marconi's achievements, and predicted that within a few years, by means of the electron tube, or radiotron, a speech would be heard by wireless telephony in every spot on the globe that was equipped to receive it.

The audience, which had applauded enthusiastically when the names were mentioned of the four former medallists who were seated on the platform, rose as one man when Marconi received the medal from the hands of Dr. Elihu Thomson.

Senator Marconi's brief response, spoken slowly in a low-pitched voice, in perfect English, indicated one reason why he is, as he said in grateful acknowledgment, invariably warmly welcomed in this country. The

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following are perhaps the most significant words of his speech:

"I have long realized that in America, more than anywhere else, the most cordial and generous encouragement is given to an honest endeavor to apply science to useful and practical purposes. I consider myself fortunate that much of my early work in radio has been carried out in this country, for I cannot help feeling that you realize that wireless communication has become useful, and often necessary, on land and sea, besides tending to increase and simplify the facilities for closer communications between distant people on this earth, thus contributing, I hope, to make good-will take the place of the unrest and mutual suspicion which, unfortunately, seems at present to be a dominating feeling among all nations."

Before the ceremony of presentation, a dinner was given in honor of Senator Marconi, at the Engineers Club, attended by representatives of the four founder societies, members of the Board of Award, and invited guests.

The arrangements for the evening were made by a committee of which B. B. Thayer was chairman and the other members were George S. Webster, W. M. McFarland and William McClellan.

The members of the Board of Award for 1922 are:

*Representing the A. I. M. E.*—Charles F. Rand, Christopher R. Corning, Benjamin B. Thayer, Herbert Hoover.

*Representing the A. S. C. E.*—Arthur N. Talbot, Fayette S. Curtis, Arthur P. Davis, George S. Webster.

*Representing the A. S. M. E.*—Fred J. Miller, Henry B. Sargent, Walter M. McFarland, Ambrose Swasey.

*Representing the A. I. E. E.*—Comfort A. Adams, Calvert Townley, Arthur W. Berresford, William McClellan.

## Alfred Noble Memorial

THE American Institute of Consulting Engineers has placed a bronze tablet in the entrance hall of the Engineering Societies Building, New York City, in memory of Alfred Noble.

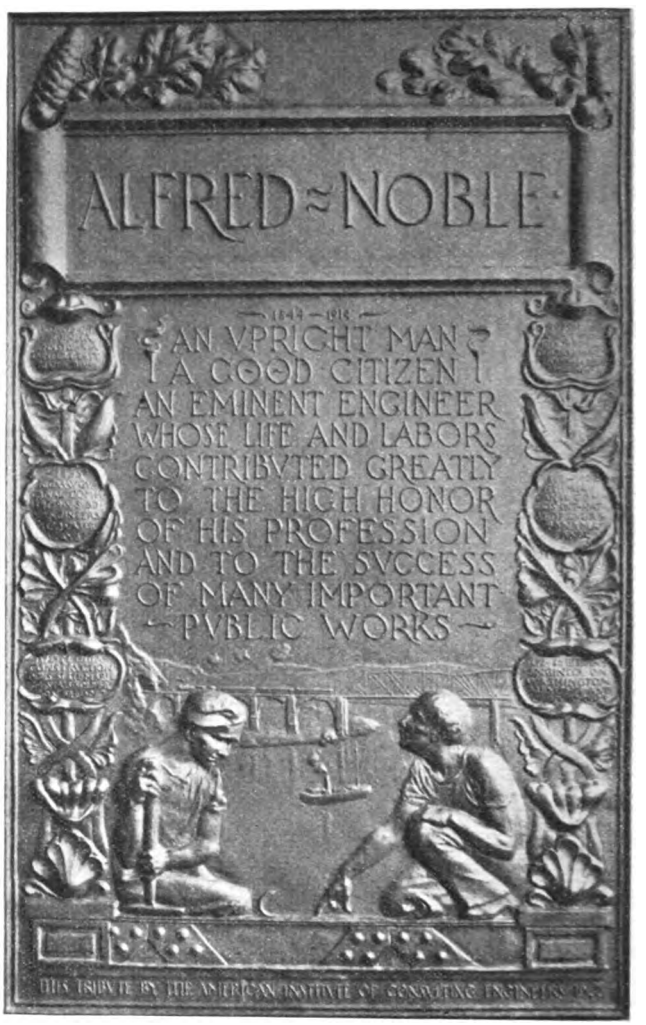
At the unveiling of the memorial, on March 15, 1922, Charles Wellford Leavitt made the opening address, telling of the life and achievements of Mr. Noble, Alex. C. Humphreys presented the tablet on behalf of the American Institute of Consulting Engineers, and J. Vipond Davies accepted it, as president of the United Engineering Society. In his speech of acceptance, Mr. Davies said:

It is peculiarly fitting that this building should be the place where shall be recorded for future years the record of his work, for he was very closely associated with and had held office in several of our professional societies. He was the recipient of the John Fritz Medal (in 1910).

In this country we have little to point out to us the persons and lives of our great engineers. We are in too much of a hurry working out our own lives to properly profit by the examples of those who have gone before. In the Institution of Civil Engineers in London, the simple names of such men as Telford, Watt, Stephenson, Brunel, Smeaton, McAdam, and scores of others are carved on the walls and their names are as household words to the growing youths.

In this building, the home of the engineering profession, we welcome the memorial to the life, work and personality of one of our great brothers.

Alfred Noble was born at Lavonia, Mich., in 1844, when the country was sparsely settled and the residents were pioneers. He volunteered as a soldier in the




NOBLE TABLET IN ENTRANCE HALL OF ENGINEERING SOCIETIES BUILDING.

Union Army on his 18th birthday, and fought with the 24th Regiment of Michigan throughout the war. He earned his way through the University of Michigan, and thus began the career which made him one of the greatest civil engineers of his time.

## Lake Superior Mining Institute

THE Lake Superior Mining Institute will hold its twenty-second annual meeting in the Copper Country, Aug. 28, 29 and 30. Headquarters will be at Houghton, and excursions will be made to various points of interest. This is the first meeting of the Institute since March, 1917, activities having been interrupted by the war and later by curtailment of copper and iron production.

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# Cross of the Legion of Honor Conferred on Institute Officers

AT a luncheon attended by engineering leaders representing every section of the country, Col. Arthur S. Dwight, president of the American Institute of Mining and Metallurgical Engineers, and Charles F. Rand, chairman of the Engineering Foundation, past president of the Institute and its present treasurer, on Thursday, July 20, were decorated with the Croix de Chevalier de la Légion d'Honneur by the French Government for distinguished service in engineering tending to closer and more felicitous relations between the two countries.

The decorations were conferred by Consul General Gaston Liebert. In a speech extolling the war work of the American engineer, M. Liebert declared that Germany had been definitely foiled in her attempt to cripple France industrially for a generation by wrecking the coal mines of northern France. Three-fourths of these mines, M. Liebert said, were in full working order and the remainder will be in complete operation within two years. The Germans thought that it would take from 15 to 20 years to accomplish this.

M. Liebert said that reconstruction is going on rapidly in northern France, two-thirds of whose industries are now working. The French Government, he said, is planning water-power improvement on a vast scale, which will soon make unnecessary for France to import a single ton of coal. He urged that French students be sent to America to study engineering.

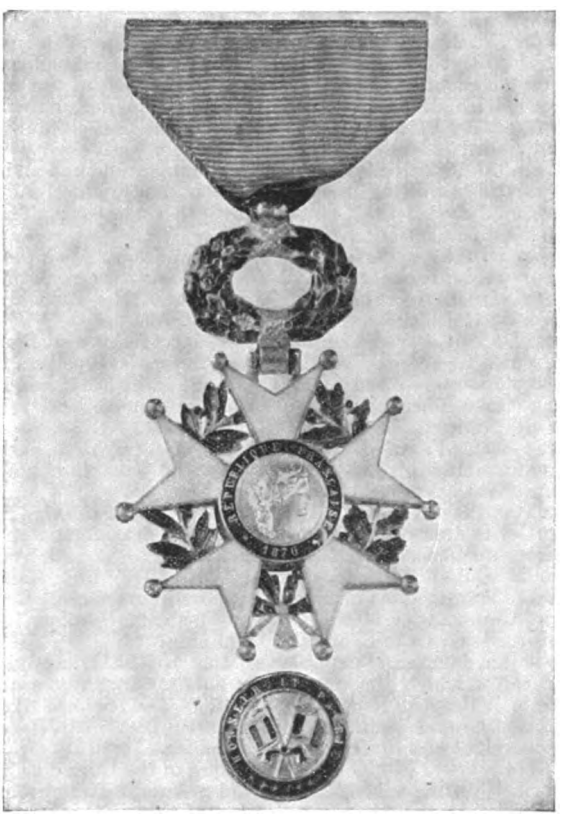
In presenting the decorations, Consul General Liebert eulogized Colonel Dwight and Mr. Rand as personifying the spirit and service of the American engineer, which, he said, was a powerful factor in the victory over Germany. He spoke of the growing friendliness between the United States and France and described this ceremony as an epoch in international relations.

Calvin W. Rice, secretary of the American Society of Mechanical Engineers, who presided, repeated that international unity among engineers was the dream of Andrew Carnegie, who saw in the efforts of the engineer and the scientist the hope of civilization. Mr. Rice said in part:

In the Declaration of Independence occurs the statement that all men are created free and equal. Jefferson was familiar with the writings of Rousseau. In fact, he was a remarkable linguist notwithstanding that he wrote the Declaration of Independence when only 32 years of age. He was one of the very few ambassadors in the history of the United States who could speak the language of the country to which they were sent.

The interpretation of the passage in the Declaration of Independence is that all men have equal opportunity, not that they are born with equal ability.

With the French Revolution all the previous orders were discontinued and the more democratic ideas such as those of Rousseau in France and Jefferson and Franklin in the United States, have prevailed. Napoleon, on the other hand, recognizing the desire to excel which is inherent in everyone, after coming home one evening from a big reception, and while surrounded by his ministers, proposed the re-establishment of some method of recognition which would be along democratic lines. The national order of the Legion of Honor was the result.



CROSS OF THE LEGION OF HONOR. THE MEDALLION BELOW SHOWS THE REVERSE SIDE OF THE MEDALLION IN THE CENTER OF THE CROSS.

Whereas in the previous 1000 years knighthood had been almost exclusively confined to those making great achievements in war and was more or less confined to the nobility, and while at the present time persons of wealth are suspected to have attained their decorations by some payment, so much so that there is at the present moment a committee of the House of Parliament to investigate the subject, France is the one country of the world which has succeeded in according recognition for attainment in every walk of life. It is inconceivable, therefore, that with the care which France has exercised these 120 years, there would be any suspicion about the method of determining those who shall be the recipients of this high honor.

I shall assume the role today of nominating, so to speak, to the representative of the French Republic the two friends who are to receive the Cross of the Legion of Honor, but before doing so I want to say a word about the long and devoted career of our guest of honor, the Consul General, M. Gaston Liebert:

M. Liebert comes of a very old French-Flemish family and has a long list of illustrious ancestors who served France in many

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capacities, in many parts of the world. M. Liebert himself was educated in Germany and England, and later admitted to the French Naval College. He has served as a French Naval Officer and as a member of the French General Staff (Navy). He has been sent on confidential missions by his government to many parts of the world; was in China during the Boxer Rebellion and was in the Far East during the whole of the Russo-Japanese war, where he organized a service of quick cable information for Paris, London, Pekin and French Indo-China concerning the political, military and naval events. In 1912, he was made Consul General, and came to the French Consulate General of this country in 1916. Besides M. Liebert's activities in direct behalf of his government, he has always had very close to his heart the furthering of friendly relations between the Americans and Frenchmen and has participated in many engineering activities. During the war he acted in close coöperation with the French Embassy, the French High Commission and the different American and French societies for the mutual benefit of the two countries. In the meanwhile, he was instrumental in the organization of the General Association of the Alsatian-Lorrainers, in the Association of Societies of French Language, of the Franco-American Board of Commerce and Industry, of the American Committee for the study of French Colonial Affairs, etc.

The two friends whom we nominate today have long been identified with engineering.

Colonel Arthur S. Dwight, president of the American Institute of Mining and Metallurgical Engineers, was the chairman of the committee of engineers which in this section of the country did as much as any one act to wake up America, namely the "Preparedness Parade," and was one of the first civilians to be commissioned in the Reserve and to enter active service. As Major in the First Reserve Engineer Regiment, he had an important part in recruiting and training that body which sailed for France on July 14, 1917, as the Eleventh Engineers. This was the first unit in action of the A. E. F.

Major Dwight served in France for more than 22 months. He was honorably discharged in May, 1919, with the rank of Lieutenant-Colonel, receiving the D. S. O. from the British and a citation by General Pershing of the U. S. Army.

Mrs. Dwight served also in France during the war, first with the French Red Cross and later as Regional Directress of the women workers with the Y. M. C. A. She was decorated by the French Government with the Croix de Guerre and received other citations.

Mr. Charles F. Rand after a long period of work as executive in great mining projects brought to the several engineering organizations his talents of management.

Mr. Rand is internationally known as the head of large mining properties in this country and Cuba. He discovered the great soft iron-ore deposits of the north Cuban coast and has been active in Cuban railroad building. In 1913, Mr. Rand was decorated by King Alfonso of Spain with the Grand Cross of Knight Commander of the Order of Isabella Catolica for distinguished services to Spain and to mining.

He is an honorary member of the British Iron and Steel Institute, of which the only other honorary members are the Prince of Wales, the King of the Belgians, Dr. Richard Akerman and Baron Gustaf Tamm.

As president and director of the American Institute of Mining and Metallurgical Engineers, as president of the United Engineering Society, during which latter period we succeeded in promoting the adhesion of the American Society of Civil Engineers to this joint project of the engineering building, and now as member and honorary secretary of the John Fritz Medal Board of Award and chairman of the Engineering Foundation, he has contributed much to the welfare of the engineering societies themselves as well as to what they are potentially in the world to accomplish.

Last year Colonel Dwight, as vice-chairman, and Mr. Rand, as honorary secretary of the deputation to France, carried a message of good will and encouragement from the engineering profession of the United States which was, we trust, of most permanent benefit to the development of the relations which we hope to establish between the two countries. But recognition today of attainment is not so much and is no longer solely for service already rendered as it is in recognition of the capacity to render service in the future, and I call upon you Colonel Dwight, and you, Mr. Rand, in accepting the Cross of the Legion and upon being received into the Grand Chancellory of Honor of the Government of France, which is regarded as higher than that of any other country, that you shall still further consecrate your talents to the advancement of civilization through the instrumentality of the engineering profession.

Guests at the luncheon included William Young Westervelt, John H. Dunlap, Robert Linton, J. Parke Channing, F. L. Hutchinson, George D. Barron, W. M. Corse, J. V. W. Reynders, Arthur W. Berresford, Nelson P. Lewis, Calvin W. Rice, Edward D. Adams, J. W. Lieb, James T. Grady, G. S. Webster, W. R. Ingalls, Percy E. Barbour, Federick F. Sharpless, R. L. Lloyd, J. E. Spurr, Robert A. Cummings, L. W. Wallace, R. Drouin, C. O. Mailloux, Galen H. Clevenger, A. R. Ledoux, Comfort A. Adams, George F. Kunz, R. M. Catlin, Harrington Emerson and Colonel Diederich.

## Patents Sold to Americans

THE Committee on Procedure of the Federated American Engineering Societies adopted a resolution, at its meeting on July 14, which has been sent to President Harding. This resolution says that the patents formerly owned by Germany and her allies, and, through the Alien Property Custodian, ordered returned from the Chemical Foundation, "have become the nucleus of our American synthetic organic chemical industry which must be encouraged for the sake of scientific research, public welfare and national defense."

"The Federated American Engineering Societies, through its Committee on Procedure," the resolution continues, "expresses the hope that no action will be taken without hearing representatives of chemists, chemical engineers, chemical manufacturers, the medical profession and others most directly concerned and implores that nothing be done which can, in any way or to the slightest extent, tend toward the ultimate return to former owners, of patents or other property, lawfully sequestered and sold to Americans."

## "Fully Paid and Non-accessible"

THE method adopted by a firm producing a patented article to raise capital for expansion has brought to Wall Street's notice a new and unique kind of security.

Literature has been sent out describing the business and its prospects when the capital becomes available. Accompanying the literature is a card marked "founders' card," which carries the notice that it is registered and not transferable. This is to be signed and returned if further information is desired.

Describing the company's capitalization, the circular sets forth that the shares are "fully paid and non-accessible."—*Wall Street Journal.*

**Experiments** on passing mixtures of CO and $CO_2$ over ZnO to determine the minimum ratio of $CO/CO_2$ necessary for reduction have been made by the U. S. Bureau of Mines, at Rolla, Mo., in the study of the electrothermic metallurgy of zinc. Among the interesting facts observed is the absolutely sharp line dividing the molten condensed globules of zinc from the hoarfrost or "physical blue powder."

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# Too Much Bituminous Coal

By F. S. PEABODY

Chairman of the Board, Peabody Coal Co., Chicago, Ill.

ANYTHING that may be said about "too much coal" must seem rather incongruous just at this time when two-thirds of the mines in the United States have been idle for nearly four months and a temporary coal shortage looms as more and more of a possibility. It is the purpose of this article, however, to deal primarily with the fundamental ills of the bituminous-coal industry, which, when summed up, can be expressed in one word—overdevelopment.

During recent years the bituminous-coal industry in the United States has been seldom, almost never, in a state of normal business health with production running evenly, prices steady and the market absorbing the output from week to week. There has been either a condition of feverish activity or apathetic sluggishness. We have had, for example, the intense strain on production during the war years with heatless days and lightless nights, followed by the slump late in 1918 which lasted through the greater part of 1919 when coal was a drug on the market. Then came the panicky demand of 1920. Competitive buying forced prices up to the highest levels in history. This demand in turn fell off suddenly in November, 1920, and the market remained apparently paralyzed all through 1921. During the latter year, lack of buying forced intermittent suspension of mining in all fields and prices averaged less than actual cost of production.

### Abnormal Conditions During and After War

It should be remembered, however, that conditions during the years mentioned were far from normal. The tremendous demand for coal during 1916, 1917 and 1918 was due entirely to war-time industrial activity. The general business slump which followed the war was responsible for the lack of demand in 1919. The miners strike in November of 1919, together with the breaking down of transportation under Government operation of the railroads, created a temporary artificial shortage which resulted in the scramble for coal that stampeded the market in 1920. The general business depression during 1921 was a large contributing factor to mine idleness during that year.

Assuming that business in general has passed through the post-war deflation period and will from now on continue in a fairly normal manner, what of the coal industry? Will the mines be able to operate with reasonable regularity and share in the general prosperity? The answer is negative, which brings us directly to the subject of "too much coal."

The producing capacity of the bituminous-coal mines in the United States is greatly overdeveloped. This condition existed before the war. It was intensified during the war period, chiefly through the efforts of the Fuel Administration which lent every encouragement to the opening of new mines. Prior to the war there were 6000 shipping mines in operation in the United States. At the close of the war there were 10,000. If these 10,000 mines were to operate full time they would produce 100 per cent. more coal than is needed for consumption and export. Interruptions from accidents, failure of car supply and other uncontrollable factors which seem inherent in coal mining would prevent 100 per cent. operation, even though the demand could take care of the output, and for this reason it would probably be improper to say that the industry is 100 per cent. overdeveloped. It is safe to say, however, that the present developed capacity of the bituminous mines in the United States is fully one-third greater than any possible demand.

### Overdevelopment in Capital and Men

What does this overdevelopment amount to in terms of capital and men? What effect does it have on the cost of mining coal?

First, the capital investment in active operations, including developments and improvements and a reasonable coal acreage allocated to each mine, can be safely figured at two billions of dollars. The one-third overdevelopment, therefore, amounts to nearly seven hundred millions of dollars, on which the interest at 6 per cent. is forty millions of dollars per annum.

Second, there are approximately 700,000 men employed in the bituminous coal mines. The one-third excess amounts to over 200,000 men, whose yearly wage figured at $1500 per man would come to three hundred millions of dollars.

Third, under present conditions of overdevelopment the mines must average at least 100 idle days per year. A coal mine cannot be shut down on idle days without expense. Pumps must be kept going to prevent flooding. The ventilation system must operate steadily to guard against accumulation of gases. A force of men must be employed to remove falls of the roof and do other maintenance work. Based on the actual experience of our company in operating 36 mines in 11 different districts, I figure that the cost of maintaining all of the mines in idleness for 100 days will amount to more than fifty millions of dollars.

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In dollars and cents, therefore, we have an item in the nation's yearly coal bill of about four hundred millions of dollars, which is directly caused by overdevelopment. The normal consumption of bituminous coal in the United States, including the amount exported, is between four hundred and fifty millions and five hundred millions of tons yearly. Overdevelopment, therefore, is costing about 80 cents on each ton of coal mined.

Out of whose pocket? It all depends. On a seller's market it naturally comes from the pockets of the consumer. On a buyer's market it comes partly from the operators' pockets through low prices and partly from the miners' pockets in the form of reduced working time. Each of the parties interested has taken its turn at paying and each has been prone to overlook the industry's waste while the other fellow is standing the loss.

Is there a remedy? Every now and then, particularly during a miners' strike or when prices for coal react upwards under an unusually active demand, we hear a good deal about what should be done to stabilize the industry. All of such suggestions should be considered first in the light of their effect on the excess development, for only by elimination of the excess mines and the excess men can full efficiency and low production costs be obtained.

One of the suggestions, the advocates of which are mostly politicians, is Government ownership. After our recent disastrous experience with Government operation of the railroads, I doubt if the people of the United States will even consider this proposal. Assuming, however, that it were put into effect what would be the result? The Government would have the option of closing down all of the mines one-third of the time or closing one-third of them all of the time. In either case, the expense of maintaining the excess mines would not differ from the present. If one-third of the present mines were permanently shut down and abandoned there would be an immediate loss of over six hundred millions of dollars, the entire amount of which would have to come from the tax payers, and there would be an army of 200,000 men thrown completely out of employment.

### Government Regulation of Coal Prices

Another scheme is to have Government regulation of coal prices. It is obvious that any price fixed by the Government would include a fair return to capital and a fair wage to the miners, with due alllowance for enforced idleness—anything short of this would amount to confiscation—but such prices, fixed and sanctioned by Federal authority, would simply perpetuate the waste caused by overdevelopment.

Another proposed solution, which carries the earmarks of utter ignorance, is to grant the coal industry immunity from the anti-trust laws and allow the operators to enter into agreement as to running time and distribution of output, so that each mine would receive its proportion of the tonnage available and each miner would get his share of working time. It is difficult to conceive of those operators, who by skill in management are able to run their mines more than the average number of days per year, voluntarily entering into an agreement that would cut down their running time and increase that of some of their competitors, but even could such an agreement be arrived at, we would again be perpetuating the expense of idle capital and labor for one-third of each year.

As a matter of fact, no solution has been presented that would effect the necessary cure. To those who have given the matter most careful study, it would seem that the sensible thing to do is to do nothing. Under free competition, with general industrial conditions normal, the 10,000 units of the bituminous-coal industry will be forced into a gigantic struggle for existence in which the fittest will survive and those least able to stand the strain of competition will be forced out. It is true that this will take time—probably about 10 years—but by allowing nature to take its course, we will have at the end of that period only the most efficient mines, able to produce coal at the lowest cost, and while the struggle for existence lasts competition can be depended on to maintain a low level of prices. The situation is one that is bound to work directly to the benefit of the coal consumer.

## Working Hours in the United States

ONLY one-half of the wage earners in manufacturing industries of the United States were working over 48 hours a week in 1919, as compared with seven-eighths in 1914 and eleven-twelfths in 1909, according to the National Bank of Commerce, New York City. The following table shows a comparison of the prevailing hours according to the average number of wage earners reported as working in establishments having those hours at the last three censuses of manufactures.

| | Average Number of Wage Earners | | | Per Cent. of Total | | |
|---|---|---|---|---|---|---|
| Hours per week | 1909 | 1914 | 1919 | 1909 | 1914 | 1919 |
| | (000) Omitted | | | | | |
| 48 and under | 524 | 833 | 4,419 | 8 | 12 | 49 |
| Between 48 and 54 | 481 | 946 | 1,496 | 7 | 13 | 16 |
| 54 | 1,020 | 1,818 | 828 | 15 | 26 | 9 |
| Between 54 and 60 | 1,999 | 1,543 | 1,249 | 30 | 22 | 14 |
| 60 | 2,017 | 1,488 | 828 | 31 | 21 | 9 |
| Over 60 | 574 | 408 | 276 | 9 | 6 | 3 |
| Total | 6,615 | 7,036 | 9,096 | 100 | 100 | 100 |

In 1919, according to the figures which have just become available, 1,111,000 of the wage earners were working 44 hours or less a week, 346,000 between 44 and 48 hours, and 2,962,000, 48 hours.

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# Discovery and Development of the Coal Deposits of Campine

BY E. MOMMENS

Mining Engineer, Société Générale, Brussels, Belgium

ALTHOUGH everybody is familiar with coal, few persons have an exact idea of the great importance of this precious fuel. Coal is the black bread of industry. Without it, industrial activity is much restrained; and so the great industrial countries of Europe and the United States of America are the great producers of coal.

The 1913 production of coal in Belgium was 22,842,000 tons, valued at 418,700,000 fr., nearly a half billion. In 1919, it was 18,483,000 tons, about 81 per cent. of the production before the war; in 1920, it had reached 22,414,000 tons, approximately the production before the war. To show the importance of coal production of Belgium, let us say that the coal industry employed 168,000 workers in the year of 1920, the metallurgical industry only 129,000 and the textile industry 103,000. The coal industry, then, employs the greatest number of workers. The value of the coal production in 1919 is estimated at 1,121,000,000 fr. On the basis of the production before the war, the value of the production of iron in 1919 would have been 701,000,000, of finished steel 1,086,000,000, and of zinc 415,000,000; therefore, in 1919 the value of the coal industry was greater than that of the metallurgical production.

### Coal Production in Belgium Compared

What is the situation of Belgium, from the standpoint of coal production, in comparison with other countries that mine coal? The largest producer of the world, the United States of America, in 1919 produced 494,000,000 tons; England produced 237,000,000 tons; Germany, 202,000,000 tons (including lignite); France, 22,428,000 tons; and Belgium, 18,500,000 tons. (This figure in 1920 was increased to 22,414,000 tons.) Hence, in 1919, Belgium occupied fifth place among the great coal producers of the world. Before the war, it was exceeded by Russia which produced 34,000,000 tons in 1913, and in 1920 was exceeded by Japan, which mined 29,000,000 tons in that year.

The coal production of Belgium for the last 15 or 20 years has remained nearly constant, setting aside, of course, the production of the years of the war. The maximum production was attained in 1910, with 24,000,000 tons, and the minimum in 1905, with 22,000,000 tons.

Until the year 1910, the Belgian production was greater than the national consumption. Since that year, production has not been equal to the consumption. Coals for gas and coke have been more and more lacking, and we have been obliged to supply our needs in this quality of coal from our neighbors, principally Germany. Happily, investigations have been started by some manufacturers; they are about to increase production and supply the quality of coal needed. In fact, some boring has already been completed in the south of Hainaut and in the province of Liége. They have discovered, especially, that the coal measures of Hainaut extend beyond the limits known until recently, and the mining of these measures will permit a revival of activity of the coal industry, when the Government wishes it; the giving of the desired grants will be all that is necessary.

### Discovery of Coal in Campine

Other investigations, more scientific and more interesting, have been carried out in Belgian Limbourg, since 1898. They have led to the discovery of an entirely new basin of which the area measures, from actual knowledge, more than 160,000 ha. The credit for the discovery of this incalculable treasure belongs to a professor of the University of Louvain, André Dumont, who died in November, 1920. He was the son of the Belgian geologist André Dumont, whose statue stands in front of the university at Liége.

The discovery of this basin is one of the most remarkable conquests of science. Here is the story: In 1876, Guillaume Lambert, professor at the University of Louvain, while studying the measures of Dutch Limbourg and the geological characters which these measures presented, concluded that the coal formations ought to extend into the north of Belgium. This hypothesis was left undeveloped and some months later André Dumont, also studying the Dutch basin, expressed the opinion that coal measures existed in the north of our country. As always in similar circumstances, these prophesies were called rash, and the efforts of André Dumont to get together the capital necessary for the sinking of the test holes in Campine were unsuccessful; but this scholar had shown to his students his faith in the existence of coal in Campine, and some of these students when they became engineers

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and manufacturers grouped together and offered him their coöperation.

In 1898, the first company was formed for the exploration of Campine, with a capital stock of 180,000 fr. The prospect hole was started at Eelen. Driven very rapidly, then interrupted by accident, and started again three times, the boring at Eelen was stopped at a depth of 900 m., following an irremediable accident, without reaching the coal measures. The capital of the

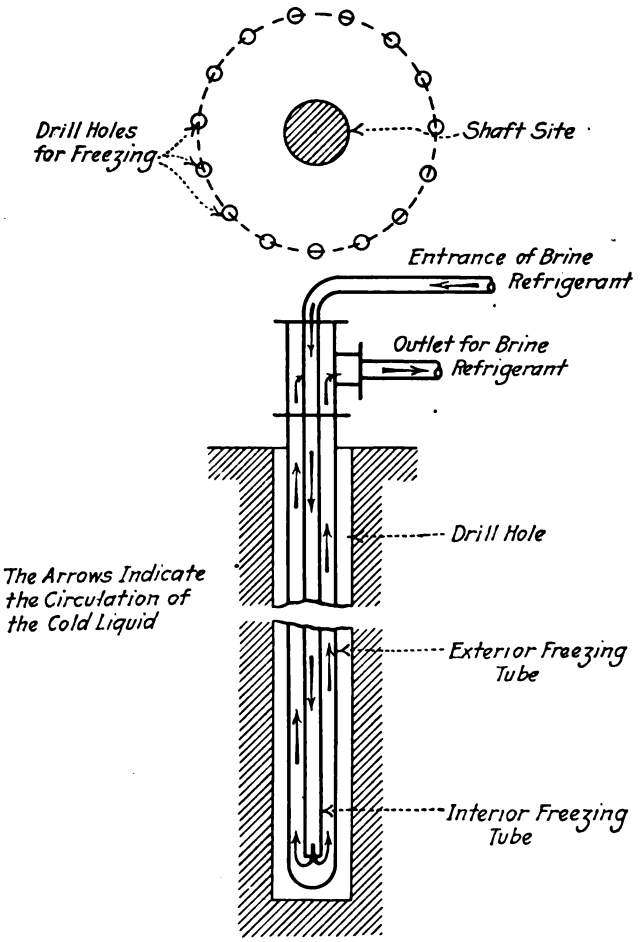


FIG. 1.—ARRANGEMENT OF DRILL HOLES AND FREEZING TUBES.

company was not sufficient to recommence operations, and a second company was founded. This company decided to drill a prospect hole at Asch. After long efforts, the drill struck, on the second day of August, 1901 (historic date), the first bed of coal in Campine. The efforts of the scholar received their reward and the presence of coal in the soil of Limbourg was proved.

Here can be applied the proverb, "Misfortune is sometimes a blessing." Scarcely 1500 m. from the village of Eelen where André Dumont sank his first prospect hole, was found a large depression of the coal measures which extends into Holland; in other words, a deep subterranean valley where the coal measures are at an enormous depth and of which drill holes have not yet touched the bottom. Suppose that André Dumont had succeeded in his first drilling at Eelen; probably he would have risked a second hole some thousand meters from the first, and no doubt would have hit the immense valley without having found another trace of coal, and would have concluded that there was not a large coal basin in Limbourg.

André Dumont should be considered a great benefactor of Belgium. He gave his country a reserve of coal which is estimated at more than 8,000,000,000 tons. Among the coals discovered are found the qualities necessary for the manufacture of gas and coke; qualities that Belgium is obliged to buy from foreign countries.

### MANY DIFFICULTIES ENCOUNTERED

It was necessary to overcome numerous difficulties to prove the existence of coal in Campine. A thousand new difficulties arose as soon as an attempt was made to value the discovered treasure. The coal is found at a very great depth in Limbourg, at approximately 525 m., and it was necessary to sink a deep shaft before touching the precious coal. This shafting is most difficult because of the grounds, filled with water, which cap the coal deposits. These grounds, called "dead grounds," because they contain no minable substance, are composed of sands, clays, fissured chalks, marls, limestones, etc. From these fissures come streams of water that at certain places spout to a great height and with great violence, like veritable artesian wells. How are such floods of water to be fought? It would be necessary to have pumps so powerful that room for them could not be found in the shafts, while sinking. And this is not all; the sands are so impregnated with water that they become running sands; that is to say, they are mixed intimately with the water to form a sort of liquid mud, which cannot be excavated. They are like the sands of the seashore which remain impregnated with water when the tide goes out, so that a hole dug in the sand soon fills up. This is the condition found in Campine, with this difference, that at the end of a certain time the sands of the seashore, under the action of the air, the sun and the wind, will dry out; while at Campine undergound springs continue to fill the sands with water.

### METHOD OF FREEZING THE GROUND

The method employed to overcome this difficulty is the freezing of the ground. This process, first suggested, it is said, by a French superintendent of the mines at Anzin, was really put to practical use by a German named Poetsch. The principle of the freezing process is as follows:

When a shaft cannot be excavated in the liquid mud, the mud is frozen so that it can be dug out like a block of ice. The advantage of this method is that the walls of the shaft, at the point where they cave, can be maintained and the belt of ice around the shaft prevents the exterior water from running in so that it is possible to sink an absolutely dry shaft without costly pumps, difficult work, obstructions of the shaft, etc.

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The ground is frozen in the following manner (see Fig. 1): Bore-holes, from 0.15 to 0.20 m. in diameter, are drilled around the shaft to be sunk, to the depth that the shaft is to be excavated. In these drill holes, are placed what are termed freezing tubes, which consist of two pipes, one inside the other. At its lower end, the outside pipe is closed with a circular cap and the inside pipe is left open. At the upper end a pipe fitting is placed, in the form of a tee, of which the branches are connected to the pumps that force through the pipes the freezing liquid, cooled to a temperature of from 20° to 22° below zero. The cold liquid enters through the inside pipe, escapes at the lower end and comes back up in the annular space left free between the two pipes. This liquid gives part of its coldness to the ground to be excavated and in the end freezes it solid. The liquid, of course, becomes warmer, but the refrigerating machines re-cool it and the cycle begins over again.

The bed of ice which is formed around each freezing tube increases daily (Fig. 2) until it extends to the body of ice around the neighboring tubes and thus forms a complete band of ice around each shaft to be excavated. This belt of ice is thickened and strengthened, and when it attains sufficient size and solidity to hold the exterior water, the shaft can be sunk easily and without danger. The interior and exterior freezing pipes in the different holes are fastened to each other by means of two heavy circular fittings, on which are branched the discharge and suction pipes from the pumps that circulate the freezing liquid.

Such an undertaking as sinking a shaft by freezing necessitates, at the beginning, a thorough study of all the conditions that will be presented in the course of the work. At the André Dumont coal fields, four bore holes were first drilled, at different places on the grant, to fix the location of the shaft. These holes showed the nature of the formations to be gone through and gave data for the drawing of the sections of the ground to be shafted. These formations occurred as follows:

1. From the surface to a depth of 380 m., the ground consisted of very wet sands and of fissured chalks, carrying considerable water.

2. From 380 m. to nearly 480 m., the ground was formed of marls, very compact, carrying relatively little water.

3. Lying just above the coal measures, was a stratum, 5 m. thick, composed of agglomerated, inconsistent sands, carrying much water. At this depth, the water attained the enormous pressure of nearly 50 atmospheres.

At the time when the plan was being made for sinking the shafts for the André Dumont coal mines, sinking by freezing had never been accomplished at a depth of more than 350 m. It was deemed wise to sink the shaft by this method to a depth of 380 m., and beginning at this point, to dig the shaft dry, by cementing the fissures in the ground by a process of cementation that will be spoken of later. At a depth of 460 m., they would re-examine, by means of a bore-hole, the nature of the stratum lying above the coal deposits. The sinking was undertaken, therefore, following this program. The shaft reached a depth of 460 m. without difficulty, and the reconnaissance boring was made. When the water-bearing sands above the coal deposits were reached, the water made its appearance with great violence. The pipe in this drill hole was equipped with a stopcock; the force of the sand thrown out by the water was so great that the friction on the metal sides of the stopcock caused sparks of fire, and in a few days were out the stopcock.

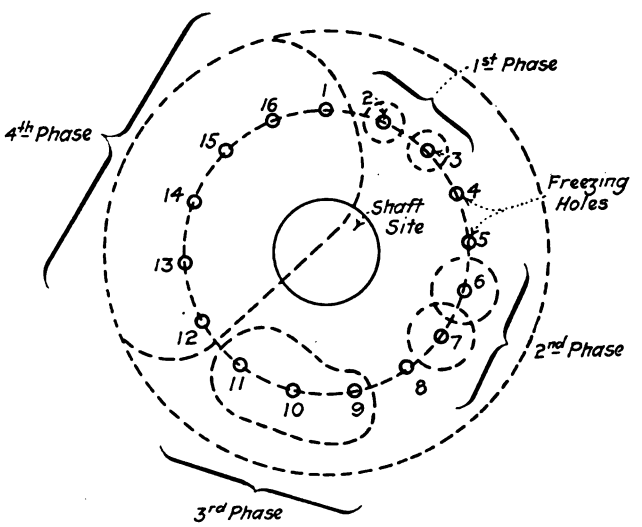


FIG. 2.—PHASES IN FREEZING OPERATION. EACH PHASE IS PRODUCED AT THE SAME TIME AT ALL HOLES, BUT TO SAVE SPACE THE SUCCESSIVE PHASES ARE SHOWN ONCE ONLY.

1st phase: A thin bed of ice is formed around the freezing tubes.

2nd phase: This bed of ice increases and joins the neighboring beds.

3rd phase: The beds of ice, joined together, form a weak belt of ice around the shaft.

4th phase: This belt increases until it reaches the center of the proposed shaft.

This circumstance caused the company to try to freeze the earth at a depth of 460 m. This work was very difficult. It was necessary to sink new bore-holes inside the shaft, in which to place the freezing tubes. In digging the 5 m. of water-bearing stratum above the coal measures, it was necessary to bore 60 holes, making a total of almost 3500 m. (3.5 km.) of hole for freezing tubes.

## THE REFRIGERATING MACHINE

The liquid to be sent into the freezing tubes is cooled by refrigerating machines which operate on the following principle:

Vaporization of a very volatile liquid, which obtains the necessary heat of vaporization from another liquid, and thus cools the second liquid. The very volatile liquid chosen is ammonia or sometimes carbonic acid. The refrigerating machine, Fig. 3, is composed of:

1. A compressor, *A*, by means of which is accomplished the vaporization of the liquid ammonia in a

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refrigerant and the compression of the gas in the condenser.

2. A condenser, *B*, or liquefier in which the ammonia gas is liquefied under the combined action of pressure and the coldness distributed by the circulation of water around the coil in which the ammonia liquid flows.

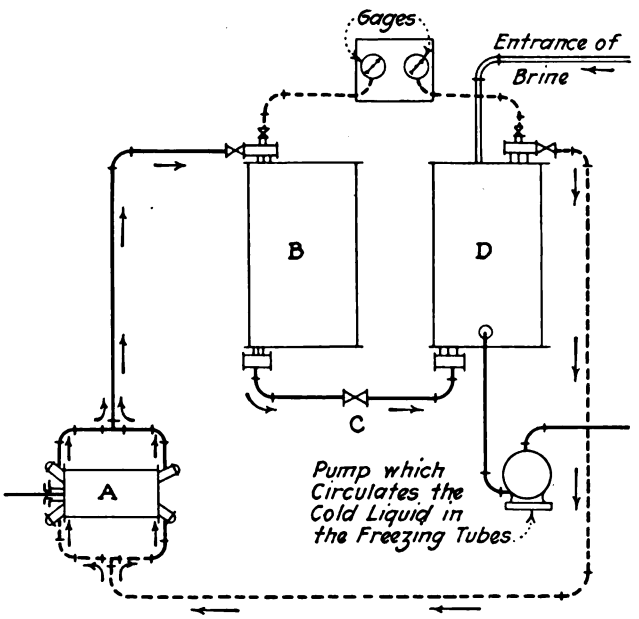


FIG. 3.—THE REFRIGERATING MACHINE. THE ARROWS INDICATE THE CIRCULATION OF THE AMMONIA, WHICH IS IN THE LIQUID STATE BETWEEN THE CONDENSER, B, AND THE REFRIGERANT, D, WHEN PASSING THE REGULATING VALVE, C, AND IS IN THE GASEOUS STATE BETWEEN THE REFRIGERANT AND THE CONDENSER WHEN PASSING THE COMPRESSOR, A.

3. A regulating valve, *C*, which produces the fall of pressure between the condenser and the refrigerant.

4. A refrigerant, *D*, or vaporizer, in which the ammonia liquid is vaporized at a constant pressure under the effect of the suction of the compressor, taking the necessary heat of vaporization from the liquid that encircles the coils.

The liquid is nothing but water to which salt is added to prevent its freezing. The salt employed is chloride of calcium or magnesium. The pumps force this cold liquid into the refrigerants, from which it issues into the freezing tubes, as described. This circulation of liquid cooled to 20° below zero lasts five or six months depending on the depth of the ground to be frozen. When the freezing is finished the shafts can be sunk, but during all the process of excavation, the circulation of the cold liquid is maintained to prevent the thawing of the water-bearing ground. The sinking method is not unusual; explosives are used and the muck is removed through the shafts. When the cold liquid is no longer sent into the freezing tubes, the ground will thaw, by degrees; it is then necessary to strengthen the walls of the shaft by a revetment which must fulfill the two following conditions:

1. To maintain the walls of the shaft and to prevent the pressure of the earth and water from causing them to yield, as this would cause caving in of the shaft.

2. To be watertight so that the water cannot enter the shaft and subterranean work, as this would necessitate continual and costly de-watering and render the work difficult and dangerous.

This revetment, called tubbing, is made of cast iron. The cast iron, being practically non-porous, renders the shaft water tight, and, being rigid and strong, maintains the walls of the shaft and is able to resist strong pressure.

### A DOUBLE REVETMENT

As its name indicates, the tubbing is a kind of tub, without a bottom. It is composed of many pieces of cast iron bolted together, to form a ring. These rings are piled, one on another, and fastened together with strong bolts. Between the different pieces and the different rings and bolts are laid strips of lead, to keep out the water. Each time a certain depth of shaft (a "case," as the miners call it) is sunk, say, 50 to 60 m., a portion of the tubbing is placed, but if the rings are only placed one on another, the water which cannot enter the shaft through the tubbing will pass along it and pour out at the base of the tubbing. It is necessary, therefore, to apply to the base of the tubbing something to prevent the infiltration of the water into the shaft. The device used is called a breeching. A breeching is a cast-iron ring which differs from the tubbing rings in that it is thicker and not so high. A tubbing ring measures 1 m. to 50 cm. in height; a breeching ring only 25 to 30 cm. This breeching is placed at the bottom of each "case" excavated, with strips of lead between each portion.

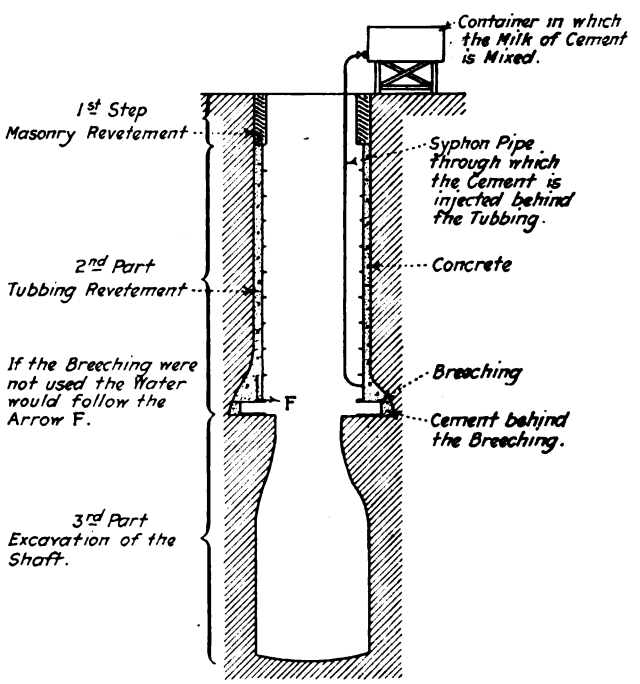
Container in which the Milk of Cement is Mixed.
1st Step Masonry Revetement
Syphon Pipe through which the Cement is injected behind the Tubbing.
2nd Part Tubbing Revetement
Concrete
If the Breeching were not used the Water would follow the Arrow F.
Breeching
F
Cement behind the Breeching.
3rd Part Excavation of the Shaft.

FIG. 4.—SHAFT WITH ITS COMPLETE REVETMENT.

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Cement is poured behind the breeching to close the joints through which the water can enter On the breeching are placed and bolted the successive rings that form the tubbing In proportion to the increased depth, the thickness of the walls of the rings increases. At the top of the shaft, the rings are 2.5 cm. thick, at the bottom of the shaft the thickness may reach 12 to 15 cm. With this thickness, the rings are heavy. For a shaft 6 m. in diameter, like those sunk in Campine, a complete tubbing ring at the bottom of the shaft weighs from 30,000 to 32,000 kg. These rings are in 12 pieces or segments, one segment weighing approximately 2700 kg. (nearly 3 tons).

To better assure the watertightness of the shaft, when the tubbing is entirely in place, a milk of cement (cement mixed with water so that it remains liquid) is injected behind it with a siphon. This liquid finds its way into the smallest interstices left behind the tubbing; the cement is deposited in these openings and seals them. A double revetment has then been constructed in the walls of the shaft (Fig. 4), a revetment of concrete and one of cast iron, so that the whole is strong and watertight. When the tubbing has been placed in the entire depth of a section (50 to 60 m.) excavation of a new section is undertaken below the first, and so on.

When the ground is clayey, which swells under the freezing action, the tubbing is placed as the shaft descends, to prevent accidents. Each time that a depth of 1.5 m. is excavated, a ring of tubbing is set, solidly suspended to the pieces fitted into the shaft. A new depth of 1.5 m. is then dug, which is maintained with a ring of tubbing bolted to the first, and so on, so that, in descending, the tubbing follows the excavation.

This work is long, complicated and demands skilful workmanship. Naturally, it entails heavy expense. The excavation, alone, by freezing, before the war, cost an average of 6000 fr. per lin. m. of shaft, for a shaft of 6 m. in diameter. Now the cost runs from 24,000 to 25,000 fr. The cost of the tubbing amounted, before the war, to nearly 2,500,000 fr. for one shaft 600 m. deep. Now 9,500,000 fr. are required. So that, for a shaft 600 m. deep and 6 m. in diameter, it is necessary to spend for the digging and the walling with tubbing the sum of 25,000,000 fr.; and for this money we have only a deep excavation in the ground.

To extract the coal, a second shaft is required for ventilation, hoisting engines are needed, a power house must be built, also boilers and houses for the workmen, because Campine is sparsely settled and it is necessary to attract and to hold workmen in order to give the coal basin any value. All this work necessitates the raising of considerable capital. It is estimated that approximately 100 millions will be required to furnish the equipment for the extraction in Campine. The coal companies of Limbourg must be fortified with powerful financial resources to undertake this work.

### Companies Operating at Campine

The coal basin of Campine is now granted to seven different companies. One grant, that of Houthaelen, is not at present given over to an operating company and three zones are reserved to the state. In going from east to west (Fig. 5) we have first the Société des Charbonnages de Limbourg-Meuse, owner of two grants: Saint Barbe, 2170 ha., and Guillaume Lambert, 2740 ha. The capital stock of this company is 50,000,000

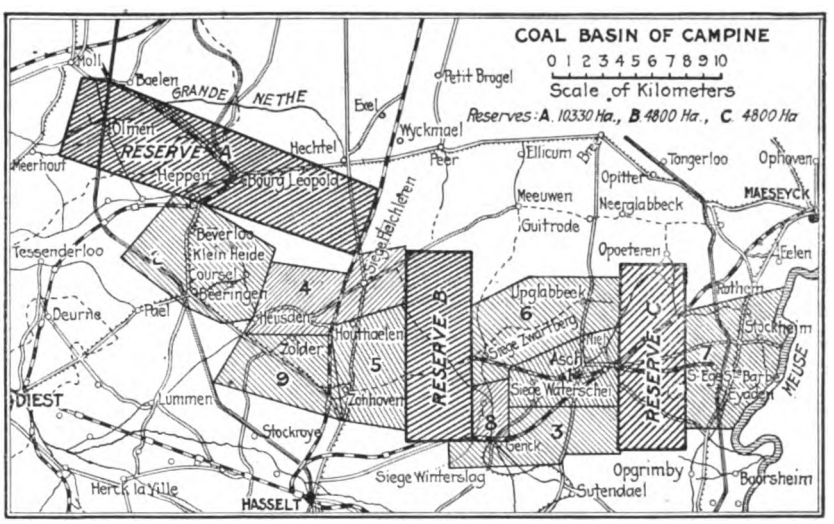


Fig. 5.—Chart showing grants in the coal basin of Campine.

1. André Dumont-sous-Asch.
2. Beeringen-Coursel.
3. Genck-Stutendael.
4. Helchteren.
5. Houthaelen.
6. Les Liégeois.
7. Ste. Barbe and Guillaume Lambert.
8. Winterslag.
9. Zolder.

fr. It has issued also 50,000,000 fr. in bonds, so that the capital at its disposal for the installation is about 100,000,000 fr. Then comes the state reserve, *C*, undeveloped at present, with an area of 4800 ha. To the north, there is the grant of the Liégeois, with an area of 4269 ha. which will be developed by the Société Anonyme pour l'Exploitation de la Concession Charbonnière des Liégeois en Campine. Its capital stock is 50,000,000 fr.; so far, it has not issued bonds. Below this grant, is that of André Dumont, with an area of 3080 ha. La Société des Charbonnages André Dumont, which is developing this, has a capital stock of 50,000,000 fr., with no bonds. To the south is the grant of Genck-Stutendael, with an area of 3000 ha., controlled by La Société des Charbonnages de Ressaix, Leval, Péronnes, Saint Aldegonde et Genck.

Between the grants of the Liégeois, André Dumont and Genck-Stutendael, is the Winterslag grant of 960 ha., with surface development by La Société des Charbonnages de Winterslag. This company is the only one so far that has worked, commercially, the coal in

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Campine. It has taken out, during the period of 1920–1921, 270,000 tons of coal. It counts on producing 2000 tons per day in 1922, so that this company should mine 600,000 to 700,000 tons of coal per year; that is to say, the production of our largest producers in the basin of Hainaut and Liége. The capital stock of this company is represented by 12,000 shares without nominal value, carried on the accounts for records. It has issued 60,000,000 fr. of bonds.

The second zone is reserved by the state; reserve *B*, with an area of 4800 ha. Nothing has been done so far to develop it. Next to this grant, is found the Houthaelen grant, with an area of 3250 ha. The company destined to exploit this area has not yet been formed. Near Houthaelen, are found the two grants of Helchteren and Zolder each with 3240 ha. These grants will be developed by La Société des Charbonnages de Helchteren et Zolder, with a capital stock of 50,000,000 fr. and no bonds. It is the largest company in Campine, from the standpoint of the area of grants. Then comes the grant of Beeringen-Coursel with 4950 ha. The development of this grant will be undertaken by the Société des Charbonnages de Beeringen, with a capital stock of 50,000,000 fr., 20,000,000 of bonds, making a total of 70,000,000 francs. To the north of the Helchteren and Beeringen grants, and bordering on them, is reserve *A*, very valuable to the state, with an area of 10,380 ha. Nothing has been done so far to develop it.

A total of 31,000 ha., in round numbers, has been granted in Campine to individual companies which have made an investment of 380,000,000 fr. to improve the holdings. These companies have worked for 13 years to develop and exploit their grants.

### Progress of Development

At the Charbonnages de Limbourg-Meuse, shaft No. 1 reached the coal-bearing stratum in August, 1917, during the German occupation, at a depth of 476 m. and now has reached a depth of 750 m. Many beds of rich coal (0.5 to 1.52 m.) have been pierced. Shaft No. 2 is in the process of sinking and has struck the coal formations. This company, undoubtedly, will be the second to mine coal in Campine.

At the Charbonnages des Liégeois, shaft No. 1 is completed. It struck the coal measures at 560 m. and has reached a depth of 642 m. Shaft No. 2 is in process of sinking, and has reached a depth of about 100 m. Many seams of coal have been cut in shaft No. 1. The thickness of the beds at this colliery is very small (0.57 m.), but others can be found, no doubt, of greater value. The coals are from 30 to 35 per cent. volatile matter.

Shaft No. 1 of the Charbonnages André Dumont reached the coal measures at a depth of 505 m. and has gone down more than 530 m. In shaft No. 2, the freezing process was started about the end of November, 1921.

At the Charbonnages d'Helchteren et Zolder, shaft No. 1 is being sunk. At the end September, 1921, it had reached a depth of 108 m. The coal measures there are at a great depth, 608 m. The freezing process has been carried on to a depth of 620 m. in a single operation, the greatest depth so far that has been attempted by the ground-freezing method. Shaft No. 2 was frozen about the end of October, 1921, and plans were made for sinking in April, 1922.

At the Charbonnages de Beeringen, shaft No. 1 reached the coal at a depth of 622 m. and was being pushed on to 647 m. when an accident occurred. Four seams of coal have been pierced at this shaft, one of which measures 2 m. 85 cm. in section with 1 m. 70 cm. of coal. Shaft No. 2 struck the coal at a depth of 624 m. and continued on to 791 m. In the 100 m. of coal formations penetrated, 10 beds of coal have been shown, of which seven have a thickness of coal varying from 0.60 m. to 1.5 m. This fact repays the effort expended, for there is certainly a good deposit, offering great opportunities for development.

## Compressed-air Illness

THE "sand hog," the toiler who delves under abnormal degrees of air pressure in the construction of tunnels or mine shafts with tons of earth and stone and perhaps a river or a bay over his head, is safer than he used to be, according to the United States Bureau of Mines. Observations made by Dr. Edward Levy, consulting physiologist of the Bureau, during the progress of tunnel work in and about New York City, indicate that the methods employed there have become so systematized and improved as almost to eliminate severe or fatal cases of compressed-air illness.

The effect of compressed air on the life, health, and efficiency of workers becomes important in the study of occupational diseases and the medical problems of industries. No thorough research has been done in this field in the United States. Knowledge of the cause, character, and treatment of compressed-air illness is still limited to a very few physicians, and thus far little interest in the subject has been evinced by the medical profession at large.

In an employment so hazardous as that of a "sand hog" some attention should be paid to the class of men best fitted for it, the Bureau of Mines declares. Caisson disease, compressed-air illness, or, more properly speaking, air embolism, is a condition caused by a too rapid decompression after exposure to higher pressures for a period of time.

Few states have legislative measures protecting the welfare of men working in compressed air. Only three states—New York, New Jersey, and Pennsylvania—have any laws regulating the hours of labor and the hygienic conditions to be observed in such work.

*Technical Paper* 285, "Compressed-air Illness and its Engineering Importance," may be obtained by addressing the Bureau of Mines, Washington, D. C.

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# Russian Mining Industry Since 1917

By E. WERCHOWSKY

In the Ore-dressing Laboratory, Institute of Mines, Petrograd, Russia.

FOR over four years, since the revolution of 1917, Russia has been cut off from the Western world. Political and general economical reforms have attracted the attention of the public and business world, but mining men have had no information as to the situation in their branch of industry, as various articles which have appeared in the European and American press gave little information as to actual conditions in our country.

When the Soviet system of government was established and private ownership abolished, it affected the

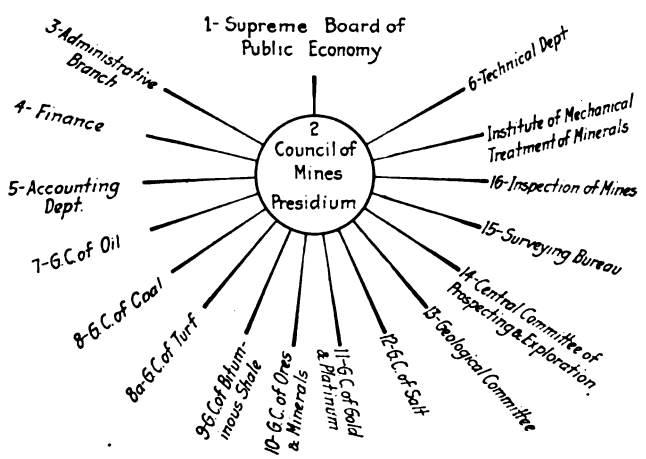


FIG. 1.—ORGANIZATION OF THE COUNCIL OF MINES.

mining industry very little at first. The power of the Soviets did not affect the Ural provinces nor Ukraine or Asiatic Russia (Siberia, Turkestan, etc.) during 1918 and 1919, and, as is well known, the mineral wealth of the republic lies within those boundaries.

In the Ural Mountains are copper, gold, and platinum; in Siberia, silver, lead, zinc, and gold, and the coal deposits in Koushetz district; in Ukraine, there are the coal fields of Donetz and the iron mines of Krivvy Rog, and silver, lead, zinc, copper, oil, etc. in the Caucasus. The mineral resources of Central Russia are the coal fields of Moscow (low-grade and brown coal), turf deposits, iron mines in Tula and Kalonga provinces, and quarries of granite and other building materials.

To control the industrial resources of the country, a Supreme Board of Public Economy (Visshy Soviet Narodnavo Khosiaystva) was established and the chairman of the board held a rank of People's Commissary. This board controlled various General Committees, such as General Committee on Electric Industry, General Committees on Food Industry, heavy and light mechanical industries, chemical industries, and so forth. The mining industry did not figure, at first, among the General Committees of the Supreme Board, but formed departments in various General Committees. For instance, iron mining was amalgamated with metal industry; coal mining was controlled by the General Committee on Fuel; quarries were under the control of local boards. However, due to the very serious fuel situation, the Supreme Board soon began to emphasize the importance of the mining industry. A thorough investigation was made by the Institute of Mechanical Treatment of Minerals[1] as to the dressing of low-grade coals of the Moscow fields; turf and bituminous-shale deposits were extensively exploited and new and up-to-date methods were introduced.

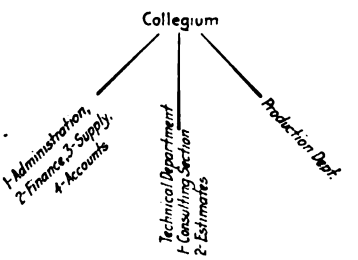


FIG. 2.—ORGANIZATION OF A GENERAL COMMITTEE OF THE COUNCIL OF MINES.

### ORGANIZATION OF COUNCIL OF MINES

Only at the end of 1919, a Section of Mines was formed and in 1920, with gradual liberation of mining provinces from Koltchak and Denikine rule, a Council of Mines was formed which included all the branches of mining, without exception, *e. g.*, gold, oil, iron, coal, non-ferrous minerals, building materials, etc. Fig. 1 represents the general scheme of the organization of the Russian mining industry as it was until the end of 1921. The functions of the different branches were:

1. *Supreme Board of Public Economy.*—Control of the whole industrial resources of the republic.

2. *Council of Mines.*—Control of the mineral wealth of the country. The Council controlled the mining industry through the medium of departments which were called General Committees (Glavny Comitet). Each General Committee controlled a separate branch of industry, such as coal, oil, minerals, shales, gold and platinum.

[1] This is a scientific institution having three sections: (1) designing dept., acting as advisor to the administration of mines on ore and coal-dressing matters, designing plants for mines; (2) research dept., where scientific researches are carried out and (3) course for graduate mining engineers who desire to specialize in ore and coal dressing.

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3. *Administrative Branch*
4. *Finance*
5. *Accounting Dept.*

} Work similar to the same departments of big limited companies.

6. *Technical Dept.*—Consulting department on technical matters, using services of specialists—electrical, mechanical, civil, mining, etc., engineers, checking and approving plans, designs, estimates of General Committees and sections.

7. *General Committee on Oil.*—Control of oil industry.

8. *General Committee on Coal.*—Control of coal industry (coal, brown coal and anthracite).

8a. *General Committee on Turf.*

9. *General Committee on Bituminous Shale.*

10. *General Committee on Ores and Minerals.*—Control of metal and non-metallic mining industry, building materials (quarries).

11. *General Committee on Gold and Platinum.*—This branch was separated from the preceding because practically all the gold and platinum in Russia are found in alluvial deposits, and the mining is different from that of copper, iron, etc.

12. *General Committee on Salt.*—Control of salt mining and mineral waters.

13. *Geological Committee.*—This committee existed as a branch of the Department of Mines in pre-revolutionary days, and as a purely scientific body remained untouched after the establishment of Soviet rule. It is doing the same work as before, like that of the Geological Surveys of England and the United States of America.

14. *Central Committee on Prospecting and Exploration.*—Doing the work of prospecting and exploration syndicates, and advising the Council of Mines as to the economic value of the mineral resources of the country. The work was guided by experienced mining geologists and engineers and carried out by prospecting parties, led by young men, graduates in mining or geology. This department, though the youngest of all, did the greatest amount of work, due to the perseverance of leaders of prospecting parties.

15. *Surveying Bureau.*—Control of survey maps, plans of mines through the medium of district surveyors.

16. *Inspection of Mines.*—This did not figure in the organization of the Council of Mines, because it was considered the duty of the trade union to look after safety and sanitation in the mines. Only in 1921 the Inspection of Mines was reëstablished, precisely on the same lines as it was in pre-revolutionary days.

Every General Committee had a technical department, a production department, supply and other financial and administrative sections. The General Committee controlled regional committees such as Ural and Siberian Committees. Each regional committee controlled several district committees, which were in direct touch with the management of the mines.

The Council of Mines had a chairman, nominated by the miners' union, and this chairman had to be a communist. It happened that the first chairman was a man who had been trained in mining, a qualified steiger,[2] but it does not happen so always and in a majority of cases heads of various government departments, nominees of the communist party, were men who had little knowledge of the industry controlled by their department. The chairman was assisted by a board, called Collegium, members of which were heads of various sections and departments of the Council of Mines, nominees of the miners' union, and also, in consulting capacity, a couple of specialists, mining engineers. The General Committees on coal, oil, gold, salt, etc. and regional district committees were organized in the same way.

## Defects of Organization of the Council of Mines

Unfortunately, this organization of the industry, though very systematic theoretically, did not work. In some cases, where the heads of departments were intelligent men, whether educated or drawn from the cultured elements of workers, who did not interfere with the work of their advisors, specialists in mining engineering, everything went on nicely. In a majority of cases, especially in the provinces and in the mines, where every action of the technical manager had to be approved by the chairman of the workers' committee, things did not go very well; every mining engineer and other member of the technical staff was suspected of being contra-revolutionary, etc. Besides, this highly centralized system was out of place in a country like Russia, where the mines are far from the civilized world and communication, even in the most populated mining district, the Don coal fields (Donnetzky Bassein) is very difficult and irregular. Political friction between the staff and the workers, lack of food, engineering materials and equipment, aggravated the situation. During General Denikine's retreat, the White Army destroyed the coal mines in the south of Russia as the Germans destroyed the mines of France and Belgium. Many of the skilled workers and miners left the mines, because of the lack of food and proper clothing. The same thing happened in the mines in Ural, Siberia and the Caucasus. Commissions of specialists were sent from time to time to inspect the mines, to report on the situation and to plan for the regeneration of the industry. South Russian coal fields, especially, were investigated, because of the acute fuel crisis.

In the summer of 1921, it was decided to organize the southern coal fields into a separate unit, and in order not to hinder its work, the managing board had its seat at Bachmut, in the heart of the coal-mining district. Extraordinary measures were taken to guarantee the food supply. Things improved a little but not to such an extent as to speak of a full re-establishment of the industry. The petroleum industry in the

[2] Steiger corresponds in English to a mine captain. A steiger has to pass through three years of a secondary mining school to get his qualifications.

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Caucasus was in a very critical position, and metal mining simply died out.

### Reorganization of the Mining Industry

As the fuel problem was the most important, it was decided to separate departments controlling the mining of fuel minerals, such as coal, petroleum, bituminous shale and turf, and to amalgamate them with the forestry department, forming a separate administration of fuel. It was also found that the work cannot be carried out properly unless the departments are headed by specialists and not by political leaders. In October, 1921, the reorganization of the whole industry (mining

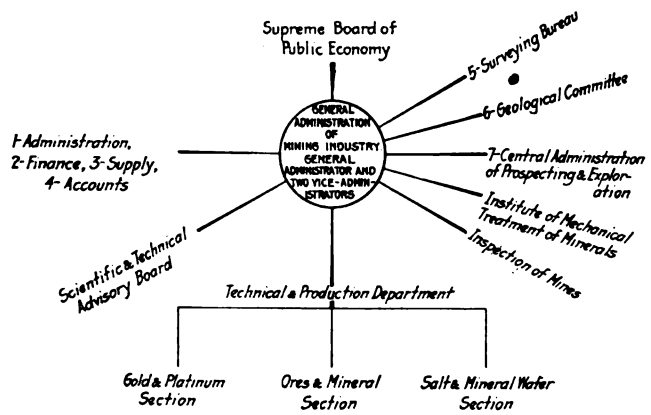
Supreme Board of Public Economy
5-Surveying Bureau
6-Geological Committee
GENERAL ADMINISTRATION OF MINING INDUSTRY GENERAL ADMINISTRATOR AND TWO VICE-ADMINISTRATORS
1-Administration, 2-Finance, 3-Supply, 4-Accounts
7-Central Administration of Prospecting & Exploration
Institute of Mechanical Treatment of Minerals
Inspection of Mines
Scientific & Technical Advisory Board
Technical & Production Department
Gold & Platinum Section
Ores & Mineral Section
Salt & Mineral Water Section

Fig. 3.—Organization of the General Administration of the Mining Industry.

and others as well) took place. The Council of Mines is called now the General Administration of Mining Industry (See Fig. 3.). General Committees are changed into sections, in charge of a single administrator instead of a Collegium, as before. These administrators are all mining engineers. All sections are under a technical department which consists of a body of specialists. The head of the General Administration of the Mining Industry is a nominee of the government and the miners' union. All reforms and actions which have taken place are with the coöperation of mining specialists.

### Organization of Trusts

All these changes so far affected the bureaucratic side of the industry. The life of the mines took its own course, regardless of the change of names and heads in Moscow and provincial centers. With the new course of economic policy, groups of mines organized themselves into trusts. For instance, several coal mines, iron mines, iron works and chemical works using the byproducts of coking, depending one on another and situated in the same district, form a trust, a self-contained unit. There are in existence a Lena-Gold Trust (formerly Lena Goldfields, Ltd.), Ural-Platinum Trust, etc. Time only will show whether these trusts can exist. These trusts are carrying out their business as private syndicates and are free to sign agreements with other trusts, buy goods and sell their products on the market.

Naturally, very little real work has been done on the mines in Russia during the last four or five years. Constant changes of government in the richest mining districts—Ukraine, Siberia, Ural, Caucasus—destroyed what was left from the time of the first revolution in March, 1917. Since 1920, mining in Russia has been in a state of organization and reorganization. Lack of technical equipment is felt very badly in the mines. The only work of the General Administration of Mining Industry that is worth mentioning is abundance of statistical data, geological and other reports and other written material which will be of a great use to the investor. The mineral resources of Russia or incalculable. A few big syndicates, mostly English, have worked metal mines in Russia—Irtysh Corporation, Tunalyk, Russo-Asiatic, Lena Goldfields, Syssert, etc. South Russian coal fields were controlled mostly by Franco-Belgian syndicates. In the coal fields of Kousnetz, in Siberia, only a beginning has been made and a big investor is needed to put the operations on a proper footing. The same can be said about the petroleum industry of the Caucasus.

### Place of Foreign Capital in Regeneration of Russian Mining Industry

The mineral wealth of Russia is open now to foreign capital. The governmental experiment did not succeed, because, in order to form a communist state, human nature must be changed. Such a change cannot be made in an instant; it will take a few generations to reform mankind.

The great war and political changes have impoverished Russia. During the last few months, since private business has been allowed by the Government, things have improved a little, but big resources are required to reëstablish the industrial life of Russia.

## Core Drilling in California Oil Wells*

By F. C. Merritt, Los Angeles, Cal.

CORE drilling, as practiced in California oil wells, is only for the purpose of taking samples at critical depths. The core drill is not intended to supplant the fishtail bit in rotary drilling.

The taking of samples by some such method is necessitated by the fact that accurate logs cannot be obtained of wells drilled by the rotary method. Oil sands are often obscured by the heavy mud used in rotary drilling, and may be penetrated easily without the knowledge of the driller. The hydrostatic pressure of the column of mud flush is sometimes sufficient to drive the oil back into the formation, so that no evidence of it is to be seen at the surface.

Core drills have been evolved for the purpose of taking samples at frequent intervals when the approximate depth has been reached, at which it is expected to encounter oil sand. It has been only within the past

* Presented at meeting of San Francisco Section, July 11, 1922.

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year that an active campaign of core drilling has been carried on in California, but at the present time it is the usual practice of many of the large oil companies in the Southern California fields to take cores at 10-ft. intervals in suspected territory.

There are two general styles of core drills in use, the single-barrel drill and the double-barrel drill. The single-barrel drill consists of a length of drill pipe, with teeth in one end. This contrivance is rotated in the bottom of the hole and at the conclusion of coring, sufficient weight is given the drill pipe to bend in the teeth.

The double-barrel drill consists of two barrels, one within the other, both fitting into a steel shoe, which is fitted with removable teeth. The mud flush passes between the two barrels to the bottom of the hole.

Both of these types have their advantages and disadvantages. The single-barrel drill is easily and cheaply made, but the cores extracted are not always to be relied on. As the mud flush does not reach the bottom of the hole by several feet, the so-called cores extracted by the single barrel are sometimes only compressed cuttings. Furthermore, there is often sufficient heat generated to fuse the material in coring, or at least to volatilize any oil that may be present in the material that is being cored.

The double-barrel drill extracts a true core without danger of contamination by the mud flush, and without burning, but it is more expensive to manufacture and to operate, and requires greater skill on the part of the operator.

Many of the companies are now using a core drill to locate the proper formation in which to cement the water string, and find that they have a greater percentage of successful water shut-offs by doing so.

Geologists are studying the cores extracted with a view to the correlation of shale strata by their contained micro-organisms. Sand cores are being analyzed for their salt and total solubility content.

The oil operator realizes that the core drill is the biggest forward step that has been made in the art of rotary drilling. What he wants now is to evolve a type of drill that will retain the speed and simplicity of the fish tail and at the same time preserve an accurate sample of the formations penetrated.

The present core barrels, of course, fall a long way short of this ideal, but they are being experimented with by all the operators in Southern California with this idea in view.

## Advisory Committee on Ferrous Metals

THE Advisory Committee on Ferrous Metals of the U. S. Bureau of Standards on which John A. Mathews and Bradley Stoughton represent the Institute, held a meeting on June 2. Doctor Stratton expressed the hope that the Ferrous Committee would be of as great use to the Bureau as had been the Non-ferrous Committee, which was the first one of its kind established by the Bureau and which has been of very great use in keeping the Bureau in touch with the technical and scientific needs of industry on one hand and giving the opportunity of accredited representatives to gain a better understanding of the Bureau's field of work on the other hand.

Among the matters discussed were the system of numbering steel of the Society of Automotive Engineers and the several suggestions as to extensions and modifications that had been recently made, particularly a report to the American Society for Steel Treating; the question of how to approach the steel manufacturers for the support of the work on deoxidizers; how the Bureau coöperates with the Patent Office; an historical statement describing the organization of the work on standard chemical samples by the Bureau and the growth and extent to which these samples are used. The question of gases in steel was discussed and it was stated that satisfactory methods for the determination of gases in steel are of fundamental importance in the study of the deoxidation of steel.

A description of work related to the study of mechanical properties of steels at high temperature which has been in progress during the past two years was given.

There is considerable discussion of the limits of certain elements in the composition of cast irons for wheels. In coöperation with the Association of Chilled Iron Car Wheel Manufacturers, the Bureau is just starting a study of the cast irons of the car-wheel composition, the object being to make a study of the elements, sulfur, phosphorus, etc.

Doctor Burgess read part of a letter from Sir Robert Hadfield on ingot practice, as follows: "Would it not be possible to have another trial made in your country on a larger scale; that is, to have a few hundred tons of rails put into the track? We are making arrangements with one or two firms on your side regarding the application of the system, so it would not be necessary to send ingots from this side as was done in a former instance, unless it was preferred to also test another 50 or 100 tons made throughout by ourselves." It was agreed that this matter would best be taken up through the American Railway Assn., by Sir Robert Hadfield.

As a continuation of the Bureau's previous work on the preparation and properties of pure iron, and iron-carbon alloys, there has just been completed a series of alloys of electrolytic iron, carbon and manganese, so chosen as to show the effect on the mechanical properties of pure iron of additions of carbon up to 1.2 per cent., of manganese up to 1.5 per cent. and of carbon and manganese together in varying relative proportions up to the same limits. All these alloys were prepared *in vacuo*.

A small problem brought up by a steel manufacturer on the use of chromium in low-carbon steels, some time ago, led to an investigation of corrosion of chromium steels. A more extensive investigation is now in progress.

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# Conservation vs. Control of Profits*

By H. FOSTER BAIN

Director of the U. S. Bureau of Mines, Washington, D. C.

THOUGHTFUL people have raised questions as to how long nature's bank could continue to accept our drafts. These questions came to the fore so persistently, and there were so many evidences —such as the failure of natural gas in Indiana, the increasing scarcity of lumber in the Lake Superior region, the progressive sterility of Southern farm lands, the choking of the Sacramento River by tailing—pointing to possible danger from overdraft or to misuse of resources and opportunity, that President Roosevelt called a conference which assembled at the White House on May 13, 1908, to consider these and related questions. This, the first great Conservation Congress, had a wide and beneficial influence on the thought of the world. It profoundly influenced the course of succeeding events and, while even yet there are sharp disagreements as to the wisdom of much that has been done in the name of conservation, I believe that thoughtful men, and engineers especially, agree that the time had come when sharp attention was properly called to the waste that accompanied development of our resources.

## Resources Large but Not Inexhaustible

In 1908 there was a surprisingly large number of men, who should have known better, prepared to argue that our resources are "inexhaustible." No competent mining engineer, of course, believes that, as regards minerals at least. They may be, and, in most cases, fortunately are, large; as to many of them our knowledge is too general to permit measuring the reserves; but we know now, and I think the public appreciates, that there is a limit to our supply of gas, oil, coal, iron, and metals. Indeed, with the intensive study made necessary to meet the demands of the war, and the more careful accounting required by the newer systems of taxation, depletion has become a common word, and that mines are wasting assets has become a platitude.

So recently as 1908 this was not so and it required real argument to convince many who were intimately concerned that there was a real and fixed limit to the materials available for industry. When attempts were made to determine the amounts available for development, only the broadest generalizations were possible and the nation found itself in the singular situation of having no inventory of its property. The first step, naturally, was stock taking. Before this was complete, indeed it never can be wholly so and our national books will need to be kept on the basis of continuous stock taking, the war threw heavy demands on all our industries. In the effort to save shipping especially, careful studies were made of our mineral resources, not only as to what was in the ground but how much and of what grades could be produced at various costs and under different schemes of development. As a result, there is now available an amount of exact knowledge that is not generally appreciated. If properly used, it will serve the nation well.

## Preventible Waste in Industry

Among the lessons learned in the course of our national stock taking were the facts that there is enormous waste in industry and that much of it is preventible. Technical methods have been greatly improved and while the actual waste is still far too great at least it may be said that conditions have been bettered. Gas wells are no longer generally turned loose to blow into the air even in fields remote from development nor are flambeau lamps burned to no purpose save the lighting of a country barnyard. Highly intelligent study is devoted to preservation of oil sands from encroachment by water; panel mining permits much more complete recovery in coal mines; caving systems do the same in metal mining; all sliming, flotation, and other improvements in ore dressing and metallurgy, permit saving what formerly ran to waste down the creeks. All these are definite and clear-cut accomplishments in which our profession may properly take pride and, what appeal equally to the engineer, these technical improvements have resulted not only in improved recovery but in actual profit. In Wyoming, $47,000 expended in conservation work on certain groups of oil wells resulted in increasing the yield of the particular wells to the extent of more than $300,000, with large incidental benefit to the field.

Many other examples might be cited, all pointing to the fact that the engineer is the best conservationist because he conserves while using, and with profit. None of us wishes to return to the conservation of the

*Read before the Puget Sound Section.

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Indian by non-use, nor will we defend willful waste, but it is right and proper that in considering conservation the economics of industry be taken into account. The engineer is thoroughly familiar these days with the significance of present values and the cost of deferring returns. A dollar won today and set to work is worth much more than the dollar that will be paid only at the end of 20 or 50 years, so it is ever the purpose of the engineer to mine out as quickly as possible all the ore that can be disposed of at a profit. This makes for the maximum amount of distributable goods as the years pass. Except for fuels, mineral wealth is largely non-expendable. More active mining merely adds to the world's stock of gold, of silver, or of iron. Properly used, the minerals are not lost in great amount and statistics show that a surprising amount of current consumption is met by remelting old metal. There is, then, no necessarily large dissipation of our resources in mining and using them freely, though in individual industries changes in use of our raw materials may be advantageously made from time to time. In the case of water power, it is clear that the sooner a power can be set to work profitably the better. The foresters have a different problem, and probably the solution there lies in the larger use of brick, stone, and cement as building materials in America, just as has followed the disappearance of the forests elsewhere.

### Conflict Between Public Policy, Economics and Engineering

With fuels the situation is different, for fuel once burned is gone. It is a most precious resource not only for heat and light but as a source of energy that may be substituted for man's labor. So far as present knowledge goes there is no sufficient supply of energy available which may be substituted. The potential water power of the United States, including even that which might be developed at costs now regarded as high, would do only the work now being done by steam and water combined and would permit of no further growth. It would require our entire corn-growing area to produce enough alcohol to substitute for the gasoline now demanded, and the land is worth more to us for growing corn. Solar, intermolecular, and other forms of energy, while known and measurable, are not practically available now. They may be in the future, but in the absence of this assurance, and with the knowledge that our fuel supply while large is limited, common prudence dictates that every effort be made to prevent waste in its production and utilization.

Unfortunately, there is a border land in which engineering, economics, and politics contend for supremacy. Freed from restrictions of cost, the engineer can reduce waste to a vanishing point, or with the unhindered guidance of economics he can produce at the highest efficiency that cost limits permit at any given moment, but when social and political considerations enter he becomes a land lubber at sea without sail or compass. Yet it is right and proper that public policy as well as technology and economics be taken into account in development of the common wealth. Our prosperity, local or national, may cost too much and the profit of the individual, under conditions, may be greater than accords with the greatest good to the greatest number. In the past, the guiding rule has been free development with unrestricted competition and the individual initiative called out under these conditions has been counted as one of our greatest national resources. Captains of industry were long our ideal. In later years there has been a change of thought and the deep underlying idealism which is the most fundamental trait of Americans has lead to revolt at the price paid for the development, the competition, and the initiative.

This new current of thought, running strong and at an angle with that of the conservationists concerned with waste of resources, has led to confusion and bitterness which has not even yet been entirely dissipated. It is one thing to want to decrease waste in development of an oil or coal field and quite a different one to attempt to control the division of profit. If all of one field were turned over to one individual or company, it might or might not be well handled, though on the average the technical results probably would be high. However that might be, it would still be an open question whether or not it would be a sound public policy to create a series of such local monopolies.

I do not desire to express an opinion on this point at this time. I merely want to call attention to the fact that there are here two separate problems involved and that in formulating public policy, which is something in which we all as citizens should take part, clear thinking requires that the distinction between the two be kept in mind. It is important that we should have the minimum of waste in the development of our fuels and if the plan which brings this about leads to inequitable distribution of wealth, there is unlimited taxing power to bring about such redistribution as may seem wise. In the oil and gas fields, competition is synonymous with water and yet our whole public policy has been to force competition. The country is now in the midst of a great coal strike which may well lead to profound changes in industry and the most fundamental fact is that there are too many mines and miners in the bituminous fields and have been for years. None the less, the National Government is today freely granting leases on its coal lands which will inevitably result in still more mines to vex a troubled industry. Thus does public policy run counter to economics and engineering.

The attempt to conserve by law has not always resulted satisfactorily. In places, conservation has become merely reservation and has resulted in waste at another point. Naval Petroleum Reserves No. 1 and No. 2 were created in California to furnish a future supply of fuel oil for the Navy. It was purposed to hold the oil in the ground as the cheapest form of storage, though this might well result in one or two year's

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delay in getting the supply to the ships in a crisis. Unfortunately, the land did not all belong to the Government and recent careful studies have demonstrated that the latter has already lost upwards of $8,000,000 worth of oil through failure to drill its land promptly. Furthermore, as a result of the relief of gas pressure through the wells on private lands instead of through uniform production, experience in other fields indicates that the ultimate total yield of all the lands, public and private, will be less than would have resulted from a different plan of development. Here conservation led to waste. Fortunately, arrangements have now been made to take out the Government oil, convert it into fuel oil which is immediately available for use but loses very little through evaporation, and store it securely for the Navy.

In the Osage Nation, there are oil lands where the structure is favorable and the ownership such that the oil can be held indefinitely in the ground. The land belongs to the Indians but the law requires the Secretary of the Interior to open it for development and to sell a certain average of leases every three months, despite the fact that royalties now accruing to the Indians are so large as to make them, I believe, the wealthiest per capita in the world. Here are reserves that might wisely be conserved for national use, but the law forces their opening and dissipation. So, too, of the most precious and limited gas, helium, millions of cubic feet are being turned into the air every day without benefit to anyone. Wise conservation legislation here would be of national benefit too large to define in words and yet so far it has proved impossible to get deserved attention to the subject.

Conservation is one of the most important matters before our people, and waste in industry can and should be decreased to an extent of which few have dared to dream, but conservation is not helped by legislating or failing to legislate when the thought in mind is distribution of the profits of industry. That is a separate problem of importance but until we learn to distinguish the two and attack each one on its merits, waste will continue and the very rich and very poor face each other as in the past.

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## Employees Representation in Standard Oil Co.*

By C. J. Hicks†

ABOUT four years ago, not as the result of any demand on the part of the men, or any threatened strike, or any stress from the War Labor Board, but simply as the result of a decision on the part of the Board of Directors that the time had come when it would be wise to invite the wage earners to have some part in helping determine the conditions of their work. their wages, their hours and working conditions, the following plan was introduced. It has been extended until today we have 13 different groups, 13 joint conferences covering our refineries, in the manufacturing fields, the producing field, in the oil field and the marketing field covering the tank wagon drivers and the men employed in the distribution of the products.

Our experience during these years has been such that when people come to us, as they do constantly, we are very free to recommend the introduction of some similar plan; not the Standard Oil plan, but some plan that may be adapted to the conditions of the industry that is making the inquiry, because we do not believe that there is any one plan that is the only plan. Our plan is quite different from that of the Colorado Fuel & Iron Co., of the International Harvester Co., or the Bethlehem Steel Co. No two companies have the same plan, although there is one fundamental feature in all of these plans, and that is what is known as the joint conference.

Men are brought together in joint conference to discuss matters of mutual interest. Our wage earners once a year elect representatives of their own number by secret ballot under conditions that assure a free election. We have no constitution or by-laws. At the first meeting of these elected representatives, with an equal number of the representatives of the management they adopt a joint agreement and go on about their business for the year. They may forget it all except that the men have elected representatives and the company has invited them to discuss subjects of mutual interest.

In the experience of something like four years, there are three outstanding facts that may be mentioned about this plan and its results. In the first place, we feel that grievances have been more satisfactorily settled than they ever were before. We have come nearer doing justice to men, because that is what every company wants to do. That is what men have a right to expect. We believe that under this plan we have come a good deal nearer than we did in the old days when the foreman and manager was rather arbitrarily obliged to settle a good many matters that are now discussed in general conference. We believe that this is the better way of approaching justice and having a square deal all around, and our experience has been that grievances are not only settled through our joint conference and joint representation plan, but the very existence of the machinery has made it easier for the foreman to settle grievances with his men. Our differences are not by any means all settled in these conferences, any more than a man's differences are all settled in court, but the court is there if we need it.

The second result has been the great help these conferences have been in wage adjustments. One fundamental principle of our joint agreement in every case is that the company binds itself to make no genera

*Address at Industrial Relations Session, February Meeting, 1922[

†Executive Assistant to the President, Standard Oil Co. New Jersey).

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wage adjustments of any sort except in these joint conferences, subject to review by the board of directors. The board of directors has not yet been called upon to exercise this right of review. Wages went up during the war period several times; they have come down two successive steps since the peak. These matters have all been settled in joint conferences, and usually by unanimous vote of the employee representatives and the company representatives. It is an evidence of the fairness and the wisdom of the men elected by the employees that they have been willing to vote to reduce wages and to go back and explain to their constituency why it was necessary for the wages to go down. That was a difficult thing to do, yet they have done it all over the country and almost unanimously.

Grievances have been adjusted more satisfactorily, wage adjustments have been made in a harmonious way. We have passed on through this period into a kind of coöperation that we believe did not exist before. The reason is plain. The foremen in a plant and the elected representatives are sitting constantly in joint conference, and that has introduced a new relationship between the foremen and the men under him. He is meeting the elected representatives of the men who are under him; a new proposition to the foreman. He is becoming more and more of a leader and a teacher rather than the boss, and that spirit goes out through his organization. The idea of the foreman sitting in conference with the elected representatives of the men under him introduces a kind of coöperation that did not seem possible under any other plan.

There is one very striking illustration of what has been accomplished in the way of securing coöperation. One of the problems during the past year has been the question of efficiency; how many rivets should a boilermaker drive, how many rivets should the riveter drive during the day? Our foremen thought they knew; they tried to establish a standard, but the men did not live up to it. It was taken up in the joint conference. The elected representatives of the men differed with the foremen. They drove rivets for a day in order that they might establish a standard, which turned out to be a little higher standard than the foremen had asked for; but it is the standard and has been since with the hearty coöperation of the men, simply because it was established by representatives of their own choosing and not laid down arbitrarily by the foremen.

Instances might be amplified to show that it introduces a type of coöperation that is intelligent and hearty and on a friendly basis. Therefore, our answer to those who come to inquire about this is: If you really want to invite men into a sort of a partnership in the management of the things they are concerned in—not in the finances, not in the question of oil in Mexico or Rumania, but in the things that concern the men—if you really want them to share with you in consulting about these matters, we do not know of a better plan than this, to elect representatives and then sit in conference.

We believe that the time has come when wage earners are going to have some voice in determining or helping to determine these things, and instead of waiting for the men to demand it and secure it on some hostile basis we prefer to invite it. Our experience has proved that it is good business. We recommend it if you really mean business, if you are willing to surrender a certain autocracy. If you surrender it, you cannot get it back, but if you are willing to surrender it we believe you will get something far better in return for it; that is, a type of coöperation that you could not get under the autocratic method.

We have gone one step farther in our stock classification plan. We have invited the men not only into a share in the management, but into a share in the business. About 12,000 employees are paying into a fund to buy stock in the Standard Oil Co., and the company is contributing fifty cents for every dollar a man puts in. Therefore, in the conferences, we are talking to stockholders; men say, "We have a new attitude on this plan, we are owners in this business." A company is fortunate if it can add to the industrial representation the distribution, in some way, of stock among the thrifty employees who are anxious to get an opportunity to invest their funds in the business to which they are giving their life. This briefly, rounds out the plan; it is an American plan, and, as far as I know, it is far in advance of any plan that any other country has produced.

## History of Copper

IN AN address on The Early History of Copper and Bronze, at a recent meeting of the Birmingham local section of the Institute of Metals, Mr. George Mullins said, that the earliest known use of copper was reported from Egypt and the Euphrates Valley probably as far back as 5000 B.C. The Cretan civilization knew copper and bronze about 4000 B.C., and after the subsidence of Cretan power the Phoenicians carried on the metallurgical tradition. Metal work began in the British Isles with the use of Irish copper tools about 2500 B.C., originating apparently under influences from the Mediterranean, probably through Spain. The first metal used in England was bronze, introduced about 1800 B.C., and was imported from the Continent, the constitution of the remains found showing that the bronze must have been made by people who had been accustomed to its use.

**Washed Coal Drying and Water Recovery.**—A comprehensive series of tests on the dewatering of washed coal sludge with vacuum filters, made by the Bureau of Mines at Urbana, Ill., led to the conclusion that where the sludge is clean enough to be of fuel value and the water supply is such that reclamation of the water is important the use of filters is practicable.

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# Evolution of Mechanical Roasting in Silver-lead Smelting

By LEONARD S. AUSTIN
Metallurgical Engineer, Los Angeles, Cal.

WHAT Colonel Dwight says regarding the treatment of oxidized ores[1] holds true also of the silver-lead smelting operations in Utah. The ore sought for was such as would, with appropriate fluxes, yield slag, and "lead bullion," as the lead reduced from the ore and carrying its gold and silver, was called. No matte, and probably little or no speiss, was yielded, and hence there was nothing to roast, either of ore or matte. But, by 1880, when I first took hold in smelting, there was quite a production of matte at the works of the Germania Smelting and Refining Co., Utah, because, by that time, ores containing some pyrite and galena were being smelted. This was due, as at the Grant Works, Denver, to the more attractive price paid for the treatment of such ores. The matte, containing about 5 per cent. copper, was accordingly heap-roasted and returned to the blast furnace for the recovery of its contained metals. By this time there had been built a long-bedded, hand-rabbled reverberatory roaster with a hearth of about 40 by 10 ft. in size, and in this matte and ore, crushed at the sampling mill, was treated. When, in 1892, I took control of this works, called now the Germania Lead Works, three other roasters had been added, but the practice of heap-roasting continued. This had the merit of needing no equipment, and of doing good work, because the pieces that were imperfectly roasted went back upon the next roast heap. At this time, when some suitable lump ore was obtainable, I roasted in heaps, in a satisfactory way. By 1892, the Bruckner cylinder roaster had been installed, which, compared with the reverberatory roaster, reduced labor. As such a cylinder revolves, a talus of ore is formed within it and at the same time fresh surfaces are exposed to the air, but the trouble was that the air did not reach to the bottom of the cylinder. This we corrected by placing a steam jet at the fire-box end, to project the air downward upon this stagnant ore, thus increasing the speed and completeness of roasting without at the same time increasing dust formation. The firing, if skilfully done, gave a somewhat sintered product, but with certain ores a slight access of heat over the normal would cause accretions to form within the cylinder near the fire end. These could be cut off by running back the fire box and barring off the crusts.

It was in 1895 that the Bruckner cylinders at the Arkansas Valley plant, Leadville, were giving unsatisfactory service and I was called in to investigate. The steam jet was put in use as at the Germania Lead Works, but we found that, due to the altitude (10,500 ft.), combustion was feebler than at sea level or even at 4000 to 5000 ft. Later it appears, as Colonel Dwight states, that R. D. Rhodes and Klots sought to increase the air supply by admission through perforated tiles, but the trouble was due to the air itself.

### Recovery of old Speiss Bottoms

I have mentioned the formation of speiss resulting from the smelting of arsenical ores, and sometimes forming bottoms 6 in. deep in the slag pot beneath the matte, and separating from it as a distinct layer. This was crushed and some fed to each Bruckner roaster charge, thereby eliminating the arsenic. At that time, also, I found beneath the ore-yard floor many thin speiss bottoms, that were buried there years before, since they were then practically a waste product. These were similarly treated to recover their gold and silver content of about $4 per ton.

Colonel Dwight makes allusion to the Williams roaster at the Arkansas Valley smelter. This consisted of a grate sustaining the charge; blast air came up throught the grate and hot charge, so that this was a kind of blast-roasting on the same principle as the B. & H. pots. I am reminded of my observations on the roasting operations at the zinc plant at Canyon City, Colo. The ore containing both zinc and lead got a preliminary roast in a blowing-up furnace, the blast rising through the ore bead as in the Williams roaster. The aim, however, was to roast in such a way as to volatilize all the zinc and lead possible. The product was then sent to the blast furnace and with fluxes was smelted to yield slag and matte, the latter containing the copper of the ore. The furnace column was but 18 in. deep, and again the endeavor was to volatilize as much lead and zinc as possible. The fumes, both from the blowing-up furnace and the blast furnace, were drawn away by a suction fan to be sent to a bag-

[1] Evolution of Mechanical Roasting. MINING AND METALLURGY, December, 1921.

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house, one of the early installations of that apparatus. The fumes there collected were purified of carbon etc., and were sold as a pigment.

It was in the 90's, however, that the mechanical roasters began to come in. These were of both the straight and the circular hearth variety, generally of a single deck, the rabble being pulled through by endless chain. At the same time, also, the multiple-hearth furnace with its central circular shaft was increasingly brought forward, and, as we later realized, was supplanting the other mechanical types. It was recognized that continuous exposure of the rabbles to the heat gradually destroyed them, and accordingly it was sought to keep these only part of the time in the furnace.

So far as the preservation of the rabble arms was concerned, the trouble was overcome in the multiple-hearth furnaces by water-cooling these arms, or by air-cooling them at the hearths where temperatures were lower. Wedge made his central shaft a hollow cylinder so large that a man might ascend in it in case of need. He covered it with tile as a protection against the heat. Of course, the rabble blades had to take the exposure and wear, but they could be promptly replaced without having to cool down the furnace.

### Use of the Brown–O'Hara Furnace

When operating the Standard Works, Durango, Colo., in 1895, where copper smelting had been formerly performed, I made use of a Brown-O'Hara mechanical roaster on lead-bearing sulfides; but a good roast could be had only by long exposure to the heat, so that considerable ferric oxide was formed, anything but good for the lead blast furnace to follow. Also, the chains and rabbles gave down and caused expensive delays.

As to the flue dust of the multiple-hearth furnace, it does not seem to embarrass the designers of a recent one called the Queen roaster.[1] This has large dropholes, and much of the roasting is done on the ore as it falls from hearth to hearth. One may say, however, that the flue dust then formed is quite recovered at a Cottrell treater. Due also to the increased area of the dropholes, the velocity of the upward-flowing gasses has been cut to one half, and so their carrying power to one-fourth, as compared with the older roasters. When Henry A. Vezin designed the Pierce turret roaster in the early 90's, he devised admission of air from the rabble arms to the hearth. This has been well carried out on the Queen roaster, where the arms are air-cooled, and the air, thus heated, is admitted to the hearth by separate air arms.

In lead-smelting practice, where the ores carry lead, any excessive heat softens the ore, making it form accretions or crusts, as already mentioned in the Bruckner cylinder. Delays caused by the necessity of barring off resulted, as well as a serious cooling of the furnace (in roasting copper ores, this trouble can not occur); and so matters proceeded. Close roasting could not be well done in a mechanical furnace, and so the older long-bedded reverberatory roasting persisted, not to be abandoned until after 1910.

About this time sintering methods began to come forward, first of all with the use of the Huntington-Heberlein pots. In these receptacles, holding about 10 tons, blast roasting was done. The air under pressure, coming up through a perforated bottom, burned the sulfur in the already heated ore, and roasted upward through the mass. The product was dumped out and broken up for use. Looking back at it, one notes the crudeness of the operation, and yet it gave a sintered product well suited to the following smelting. About this time, also, Messrs. Dwight and Lloyd had developed a machine in which the imperfectly roasted ore from a mechanical furnace was sintered. In this machine we see a uniform layer of ore, set fire to at its upper surface, being roasted by a downward draft of air sucked through the filter bed of the ore itself, so that little flue dust followed the blast downward. The ore had been fed upon an endless-chain grate, the coarser particles of the feed falling upon the grate. Thus it resulted that the finest material, even flue dust, could be roasted with the production of little dust. Of course the charge had to be made up so that it could sinter, but the product could be put through the blast-furnace, giving but little flue dust.

Consider the program! Sulfide ore imperfectly roasted, to say 13 per cent. sulfur, is made up into a sinter charge with ores lower in sulfur, even with oxidized fines, with crushed matte, and with flue dust, but in such proportions that it will sinter. This is fed to a machine that treats 150 tons per day, that gives a product that is easily reduced, that can be smelted rapidly, and that will give little flue dust. The roasting, however, must be so complete that the matte production of the blast furnace shall be kept at a minimum—say 10 per cent. Of course some matte must be yielded so as to insure clean slags; that has become the established practice, in later years.

### Sinter Speeding up Blast-Furnace Work

It has been found that, with sinter, the blast furnace can be run at a speed that would have horrified the early metallurgist. It was a prime principle with him that time must be given for good reduction. The shape of the furnace was to conform to this, having a good bosh and an expanding shaft. Now, however, this idea has changed, the furnace is straighter, the smelting column low, and yet the slags keep clean.

Supplementing these operations, nothing must be lost. The flue dust from the blast furnace is caught in a baghouse, that from the roasters and sintering machine in a Cottrell electrostatic treater.

[1] J. Moore Samuel: Queen Nine-hearth Roaster. Paper 1079-N with *Min. & Met.* (July, 1921).

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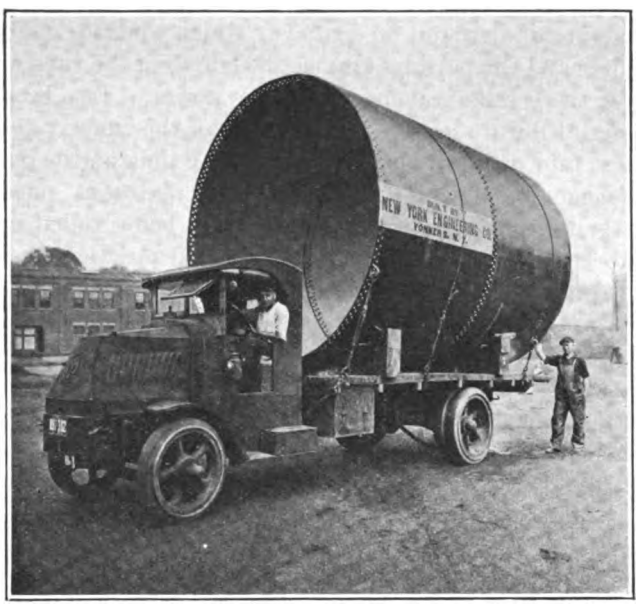
Going back to the matter of sinter roasting, Colonel Dwight has insufficiently emphasized the Dwight-Lloyd sintering machine, but has given us a good idea of its capacity and its efficiency. It is proper to add, however, that it has revolutionized the methods of silver-lead smelting, and has so added to capacity and assured continuity of operation that, were it not for this improvement, this industry would have been handicapped recently to the point of extinction, especially when we consider the growing expense of operation in the immediate past.

H. O. Hofman, in the early edition of his book on lead smelting, published in 1894, describes only the reverberatory roaster and the Bruckner cylinder. In the edition of 1906 we find, in addition, the Ropp straight line, the Pierce turret, the Brown horseshoe, the O'Hara, the Keller automatic and the Wethey described and discussed. The McDougall circular multiple-hearth type was not in use in lead smelting. The author stated that fusing the lead-bearing ore had been largely given up due to serious volatilization of the contained silver and that there was no satisfactory way of condensing the roaster fumes; that bricking the roasted ore was effective, but that a low roast was hard to get. In the 1918 edition we find that the Dwight and Lloyd roasting and sintering machine had taken first place, and that the multiple-hearth roasters were giving a preliminary roast.

With renewed activity in custom silver-lead smelting, one can only surmise the direction of improvement. Will ore, as received, be less crushed, less handled, less thrown about, and so saved rather than carried away by the wind? As a whole there should be less flue dust made, but all that is made will be caught. Will the ore be roasted in two stages on the one machine? Will it be done, perhaps, at the top of the blast furnace, and there be down-drafted to meet the rising blast, all escaping by ports in the side walls? Will the reverberatory supercede the blast furnace, as in copper metallurgy? Will roasting and smelting be continuous in the same reverberatory? To what extent will selective precipitation be carried in the Cottrell treater? Will smelter fumes be rendered innoxious or at least invisible?

## Steel Pipe Concrete Jacketed and Concrete Lined

THE Catskill Aqueduct System is one of the greatest engineering feats in the world, and for magnitude and cost, for variety and complexity of engineering problems encountered, it stands without equal. It supplies New York City, including the Boroughs of Manhattan, Bronx, Queens and Richmond with about 650,000,000 gal. of water per day. This water, which is collected back of the Ashokan Dam, 92 miles north of New York City and on the opposite side of the Hudson River, is conducted through the Catskill Aqueduct, passing under mountains, valleys and streams until it reaches the west bank of the Hudson River near Storm King Mountain where it then drops down through a shaft cut in the solid rock for a distance of 1114 ft., crosses under the river and comes up on the opposite side in another shaft. From there it ultimately reaches New York through various reservoirs, including those of Kensico and Hill View. At the Kensico Reservoir it is sterilized by the introduction of chlorine gas in a liquid state. It then goes on to New York City through pipe lines, tunnels, etc., and is




SECTION OF 11-FT. 3-IN. PIPE FOR CATSKILL AQNEDUCT SYST EM

distributed through the various boroughs by 35 miles of tunnels, some of which are 700 ft. beneath the surface of Manhattan Island. The cost of this entire undertaking, construction of which has occupied a period of about fifteen years, is about $175,000,000.

The pipe which constitutes the siphons of the two new lines that are being laid for the Catskill Aqueduct System is being built by the New York Engineering Co., of which A. C. Ludlum is president. They have devised an entirely new method of manufacturing the pipe and it would seem that this method will eventually supplant the one now in use by all others, inasmuch as it offers so many advantages such as lower costs and better workmanship. These lines extend from the Kensico Lake Dam in Westchester County down to Yonkers. The pipe is laid on concrete saddles and after all the joints are riveted together and caulked tight in the field, it is then filled with water and the pressure test applied. After all leaks are made tight and while the pressure is still in the pipe, in order to maintain it in its normal shape, a heavy concrete envelope is built around the outside of the pipe. After this sets permanently, the water is removed from the pipe and the interior is lined with two inches of concrete.

This pipe is 11 ft. 3 in. in diameter and is made from open-hearth tested steel plate ½ in. thick. The 20,000

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ft. of pipe being built will require over 10,000 tons of plate. The sheets are 7 ft. 6 in. wide and 34 ft. long and are first planed on all edges to accurate dimensions.

They are then assembled in packages of four; a steel drilling templet is placed on top of the package of plates and all rivet holes are drilled accordingly. This templet is built up from 6 in. angle irons and is rigidly braced so there is no chance for any deviation from its original shape. Holes are drilled in the templet and these are lined with a hardened steel bushing through which the drills pass.

The package of plates and its templet are all bolted together and are put on a runway which contains many rollers and the package travels the length of the runway over these rollers, being moved by power. Two large radial drills are located on each side of the runway and these four drills all operate at the same time on the one package of plates, drilling all four plates at once. After the plates are drilled, instead of being rolled up into circular section, which is the usual practice, they are pressed up in a vertical pneumatically operated press of 400 tons capacity.

It would be a most difficult matter to handle these long sheets with the usual setting of horizontal rollers on account of the large overhang of the plate. While vertical rolls could be used, still it is necessary to press the first part of the plate which is not bent in passing through the rollers. The vertical press crimps or bends the edge of the plate to its true circle as well as the balance of the plate and it is only necessary to pass the plate through the press once. The face of the dies of the press are 16 in. wide and the plate is fed forward through the press at the rate of about 10 in. for each stroke of the press. The plate being handled on edge simplifies matters a great deal as small trucks are placed under the edge of the plate and the plate is fed through the press by a cable attached to the straight end of the plate, this cable in turn being automatically wound up on a drum operated by power.

The circular seams are double riveted and the horizontal seams are of the double butt strap triple riveted type; rivet holes are drilled; all of which is in accord with the best known boiler practice. The entire sheet is dipped in a bath of diluted sulfuric acid, in order to remove all scale, and is then riveted by the hydraulic riveting method.

## Hoover and Wheeler at Chemical Exposition

THE 1922 National Exposition of Chemical Industries to be held during the week of Sept. 11–16 at the Grand Central Palace in New York will be a great scientific gathering. Herbert Hoover, Secretary of Commerce, frequently referred to as "the business man of the Cabinet" will speak before the annual convention of the Salesmen's Association of the Chemical Industry which will be held in conjunction with the Exposition. Mr. Hoover will talk on "Standardization, and What It Can Do for the American Chemical Industry." Wayne B. Wheeler, general counsel for the Anti-Saloon League, considered one of the foremost authorities in the United States on alcohol and prohibition legislation, and active in the rigid enforcement of the Volstead Act, will address the assemblage at the Exposition on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol."

Each afternoon there will be a program arranged by one of the scientific or business associations of the chemical industry, according to the plans which have been tentatively outlined. The standardization program with its many different phases will fill one afternoon session. The evening sessions will be given exclusively to motion pictures of which a number will be illustrated lectures on various developments in the chemical and allied industries. All meetings will be held in a special auditorium in the Grand Central Palace.

Every branch of the chemical and chemical equipment industries will be represented among the exhibitors, including those interested in metallurgical chemistry, as well as numerous allied houses. About 400 firms have contracted for space at the Exposition and basing predictions on present figures about 450 are looked for by the opening day. These figures compare with 83 exhibitors at the original exposition in 1915 and 427 in 1921.

## Acetylene as a Precipitant for Cyanide Solutions

CYANIDE manufactured from cyanimide contains a small amount of carbide, which upon dissolving produces acetylene, and this has led some metallurgists to believe that this acetylene might be capable of precipitating precious metals from the cyanide solutions during the ore treatment. The results obtained at The Rare and Precious Metals Station of the U. S. Bureau of Mines show that acetylene resulting from the presence of calcium carbide in the cyanide is inert as a precipitant and that any precipitation of silver is due to small unimportant quantities of hydrogen sulfide generated from sulfur compounds present in the carbide as impurities. Since there are standard methods of disposing of soluble sulfides in cyanide solutions, difficulty from this source need not be feared.

The acetylene used in the tests by the Bureau of Mines was made from a commercial calcium carbide. A number of experiments resulted in more or less complete precipitation of silver, but in no case was any gold precipitated. Silver acetylide is yellowish white, easily soluble in cyanide and highly explosive, but the precipitate obtained from the cyanide solutions was black, not soluble in cyanide and not explosive, and after appropriate tests was proved to be silver sulfide. —Serial No. 2346, Reports of Investigations, U. S. Bureau of Mines.

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# San Francisco Meeting

THE program for the 126th meeting of the Institute, to be held in San Francisco Sept. 25 to 29, 1922, is being prepared by the General Arrangements Committee of the Local Section and its details are not yet ready for announcement. The program, however, has developed to a sufficient extent to permit members to decide whether they wish to attend or not.

Briefly stated, Monday, Sept. 25, will be devoted to technical sessions which will be held at the Engineers Club, and there will be as many sessions as may be required to present the papers available, some of which are listed below.

*Brown Bros.*

SAN FRANCISCO BAY, TAKEN FROM NOB HILL, SHOWING BERKELEY, OAKLAND AND MT. DIABLO IN THE DISTANCE.

Under the registration fee plan (see July magazine) entertainment expenses during the week in San Francisco will be borne by those in attendance, not by local members alone.

Members who expect to attend the San Francisco meeting, but who will not accompany the President's party, will please notify C. H. Fry, Secretary of the San Francisco Section, 625 Market St., San Francisco, Cal., of their intention.

As announced in the July MINING AND METALLURGY, a party including President and Mrs. Dwight will be made up in the East. It will pass through the central western and northwestern states, and, it is hoped, will be joined by members from those states. The party will arrive in San Francisco on Sept. 24. After the meeting it will return to New York by way of Los Angeles and the southwestern states, stopping at several of the interesting mining centers, by invitation of the Local Sections.

Depending upon the number of persons desiring to join the party in its cross-continent trip, one or more private cars will be provided, or should the number be very small the regular train service will be used. Requests for reservations already indicate that at least one car will be needed.

The cost of the trip will remain in some doubt until the number joining it is positively known and until the traveling accommodations that will be required have been determined. It may be stated now, however, that it will not be less than $594 and not more than $873.50 per person. This will cover transportation, Pullman, hotel and meals while en route, except as noted in itinerary.

### PLEASE MAKE RESERVATION IMMEDIATELY

Reservations cannot be guaranteed if requests are received after August 15, and it will greatly facilitate the work of the agency in making satisfactory arrangements if your requests are made by wire immediately.

Messrs. Raymond & Whitcomb Company will handle all arrangements for transportation, Pullman

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and hotel reservations, and the party will be accompanied by one of their tour managers.

Requests for reservations should be sent direct to the Secretary of the American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York, with a remittance of $50 for each person, as a deposit on account. The requests will be immediately turned over to Messrs. Raymond & Whitcomb, who will conduct any further correspondence that is necessary, billing each individual according to space occupied.

### Itinerary to San Francisco and Return

Sept.

9 Leave New York via New York Central Railroad, 6.00 p.m. Dinner in dining car.
10 Breakfast and luncheon and dinner in dining car. Arrive Chicago at 9.15 p.m. Transfer to Chicago and Northwestern Railroad. Leave at 12.15 a.m.
11 En route through Iowa and Nebraska.
12 Arrive Denver 7.30 a.m. Transfer to Brown Palace Hotel—European Plan. The day will be spent in an automobile drive through the Denver Mountain Parks with luncheon at Golden and a meeting with the Local Section in the evening.
13 Transfer to Denver and Rio Grande Western Railway, leaving at 8.15 a.m. for the trip through the Royal Gorge and over the Tennessee Pass. Breakfast, luncheon and dinner in dining car.
14 Breakfast in dining car. Arrive Salt Lake City 12.25 noon. Transfer to Hotel Utah—European Plan. Visits to mines and smelters. Entertainment will be arranged by the Local Section.
15 Transfer to Union Pacific System and leave at 11.50 p.m.
16 Breakfast and luncheon in the dining car. Arrive Butte 4.50 p.m. Transfer to Hotel Thornton—European plan.
17 In Butte. Program to be arranged by Local Section. Leave via Chicago, Milwaukee and St. Paul 9.35 p.m.
18 Breakfast in the dining car. Arrive Plummer Junction at 7.15 a.m. Leave via Union Pacific System 10.25 a.m. and arrive Kellog-Wardner 12.25 noon. Afternoon at Bunker Hill & Sullivan. Arrive Wallace 7.05 p.m.
19 Morning at Hecla and Morning Mines. Leave Wallace via Union Pacific System at 2.30 p.m. and arrive Spokane 6.50 p.m. Dinner in station. Transfer to Great Northern Railway and leave at 8.15 p.m.
20 Breakfast in dining car. Arrive Seattle 8.45 a.m. Leave by Great Northern Railway at 1.30 p.m. Luncheon and dinner in dining car. Arrive Portland 8.10 p.m. Transfer to Hotel Benson—European plan.
21 Drive up Columbia River Highway. Transfer to Southern Pacific and leave at 4.00. p.m. Dinner in the dining car.
22 Breakfast and luncheon in the dining car. Arrive Sacramento 7.20 p.m. Dinner in station. Leave via Southern Pacific at 9.35 p.m.
23 Arrive Reno at 4.35 a.m. Visit Virginia City and entertainment by local committee. Leave Reno by Southern Pacific at 7.55 p.m.
24 Arrive San Francisco 7.50 a.m. Transfer to Palace Hotel—European Plan. Hotel accommodations in San Francisco include only the day and night of 24th, 25th, 29th.
25 Technical sessions at Engineers' Club. Evening, buffet supper at home of F. W. Bradley.
26 A party limited to 50 men will visit Hetch Hetchy, San
27 Francisco Water Project, under direction of M. M.
28 O'Shaughnessy, Chief Engineer. Those not taking this
29 trip will visit a number of interesting points in the vicinity of San Francisco.
30 Transfer to Southern Pacific and leave via the Coast Line at 8.00 a.m. Breakfast, luncheon and dinner in the dining car. Arrive Los Angeles 10.30 p.m. Transfer to Hotel Alexandria—European Plan.

Oct.

1 At Los Angeles. Transfer to Santa Fé. Leave at 5.00 p.m. Dinner in dining station at San Bernardino.
2 Arrive at Kingman at 5.30 a.m. Breakfast at station. Visit mines and mills near Kingman. Leave Kingman via Santa Fé at 8.40 p.m.
3 Arrive Grand Canyon at 8.20 a.m. Room and meals at Hotel El Tovar, commencing with breakfast.
4 At Grand Canyon.
5 Leave after breakfast via Santa Fé at 8.20 a.m. Luncheon at dining station at Williams. Dinner in café car. Arrive at Phoenix at 9.00 p.m. Transfer to Hotel Adams—European plan.
6 Leave via automobile at 8.00 a.m. for the trip to Roosevelt Dam and over the Apache Trail, arriving at Globe at 6.00 p.m.—Dominion Hotel—European Plan.
7 At Globe. Leave Globe by evening train for Bowie.
8 Leave Bowie 3.30 a.m. Arrive at El Paso 8.30 a.m. Leave via Rock Island Route at 12.50 p.m.
9 En route. Breakfast, luncheon and dinner in dining car.
10 Arrive Chicago 9.15 a.m. Leave via Penn. Railroad 3.00 p.m.
11 Arrive New York at 8.15 p.m.

### Technical Papers

The following papers will probably be read by title or presented in person by the authors:

Basic Principles of Gravity Concentration—A Mathematical Study. By Theodore Simons.

Factors Controlling the Capacity of Rock Crushers. By Ernest Hersam.

British Columbia Batholith and Related Ore Deposits. By P. D. Wilson.

Deposition of Copper Carbonate from Mine Water. By P. D. Wilson.

Ore Deposits of Sierra Mojada, Coahuila, Mexico. By S. F. Shaw.

Surface Tension and Adsorption Phenomena in Flotation. By A. F. Taggart and A. M. Gaudin.

Conditions of Stable Equilibrium in Iron-Carbon Alloys. By H. A. Schwartz, H. R. Payne, A. F. Gorton and M. M. Austin.

Neumann Bands as Evidence of Action of Explosives on Metal. By F. B. Foley and S. P. Howell.

Effect of Nickel Chromium on Cast Iron. By Richard Moldenke.

Sampling and Estimating Orebodies in Warren District, Ariz. By R. H. Dickson.

Sampling and Estimating at the Copper Queen Mines, Bisbee, Ariz. By R. W. Prouty and R. T. Green.

Shot Firing by Electricity. By N. S. Greensfelder.

Automatic Electric Regulation of Ball-mill Feed. By B. H. Smith.

Heating and Cooling Curves of Large Ingots. By F. E. Bash.

Metal-mine Ventilation in the Southwest. By Charles A. Mitke.

Industrial Relations in California Petroleum Industry. By Roy W. Kelley.

From Drill to Service Station—The Story of Oil in California. By Roy W. Kelley—Illustrated by lantern slides.

Mining Iron Ore in the Adirondacks. By John E. Hodge.

## Testing and Use of Permissible Explosives

THE specifications for the testing and use of permissible explosives submitted to the American Engineering Standards Committee by the U. S. Bureau of Mines have been approved by the A. E. S. C. as "American Standard."

The committee that examined the proposed specifications and recommended them for approval by the Standards Committee included representatives of the U. S. Department of Interior, the American Mining Congress, the Coal Mining Institute of America, the Mine Inspectors Institute of America, the American Society of Civil Engineers, the Institute of Makers of Explosives and the U. S. Department of Agriculture.

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# Abstracts of Institute Papers

The following papers will be printed in full in pamphlet form.
A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 22 of the Advertising Section. Discussion of papers is invited.

## Ore Deposits of Sierra Mojada, Coahuila, Mexico*

By S. F. Shaw, Esmeralda, Coahuila, Mex.

THE Sierra Mojada mining district is situated in western Coahuila, about 8 km. east of the Chihuahua state line, and about one-half way from the northern to the southern extremity of the state. It is at the terminus of the Mexican Northern R. R. The altitude is approximately 1500 m. above sea level.

The three principal rocks in the district are: limestone, agglomerate, and conglomerate or alluvium. The oldest rock in the district is a Cretaceous limestone, which is exposed in all the higher points and in the surrounding hills. In the valley, it is covered by agglomerate and conglomerate. The valley and the flanks of the mountains on both sides have been covered with a volcanic breccia designated by Garrey as agglomerate. The source of this rock is unknown.

* San Francisco Meeting, September, 1922.

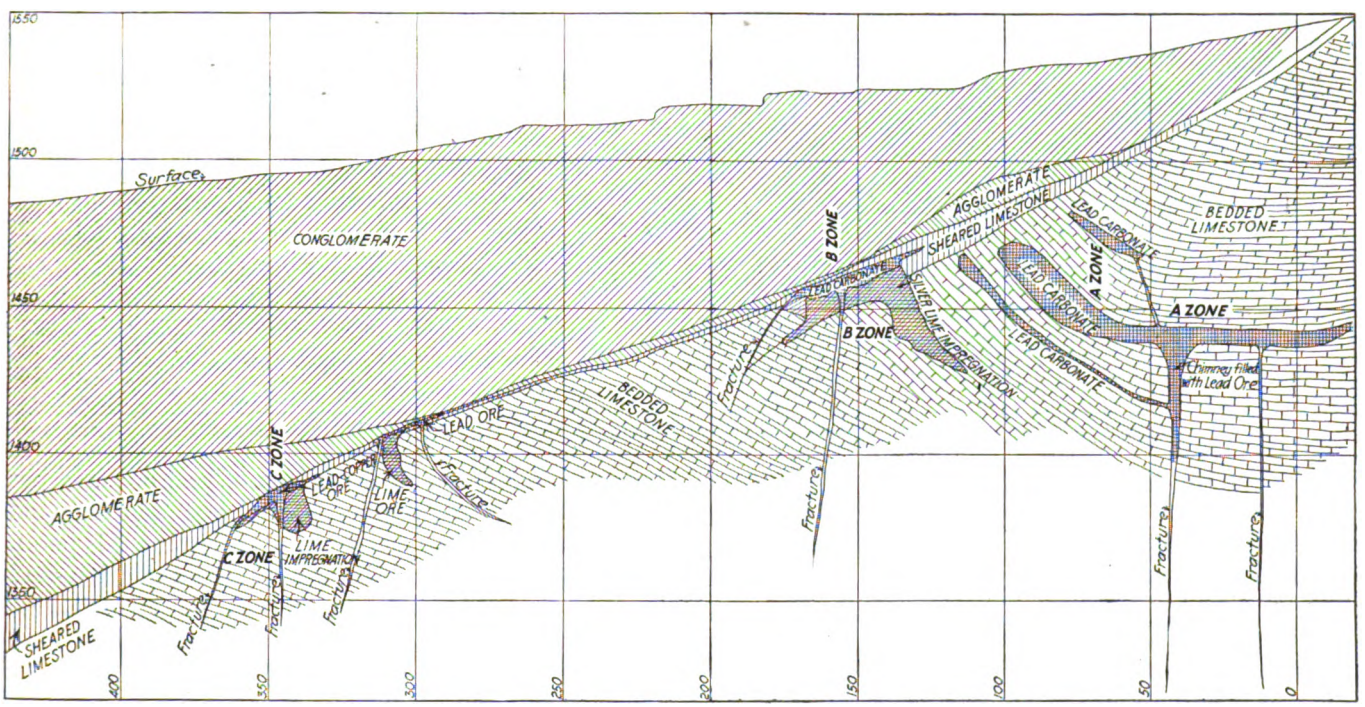
### The Ore Deposits

The ore deposits may be classified as follows:

1. Oxidized argentiferous lead ore, containing considerable iron.
2. Contact orebodies, of the following types: (*a*) Silver-copper ore; (*b*) Siliceous silver ores; (*c*) Siliceous silver-lead ore.
3. Silver impregnations in the limestone.
4. Oxidized zinc ore.

The oxidized argentiferous lead ore is found as a replacement of one or more strata of limestone along a general east-west zone of fracturing, apparently related in no way to the agglomerate-limestone contact. This ore also occurs in lesser amounts as the filling of fractures having a general east-west strike and lying to the north of the main lead orebody, under or close to the sheared limestone-agglomerate contact. The main lead *manto* was the first important orebody mined in the camp, and extraction has continued from the discovery of the camp in 1878. Complete records of production are not available.

Silver-copper orebodies have been mined from the contact in the A & B (Monterrey), San José, Fortuna,




IDEAL N-S SECTION SIERRA MOJADA COAHUILA.

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Veta Rica, Deonea, Guadalupe, Parreña, Esmeralda, Trinidad, and San Salvador mines. They occur as a replacement in the sheared limestone, generally at or close to the agglomerate contact. A large body of copper ore was found in the San José claim, which was very siliceous, and appeared to be a replacement of the agglomerate rather than of the sheared limestone. Siliceous silver ore has been mined in the Jesús María, San José, Providencia, and San Salvador mines; this ore has been of much importance.

Three series of fracture zones have been recognized, extending in a general east-west direction almost continuously from one end of the camp to the other. They were probably formed partly during the folding of the limestone, partly during the expulsion of the agglomerate, and partly by movement of the agglomerate over the edges of the limestone beds. It seems that subsequent to the movement of the agglomerate the mineralizers that formed the contact deposits rose along the two fracture zones lying to the north, deposited their contents to some extent along the fractures, and on reaching the contact spread through the sheared limestone just under the agglomerate. The agglomerate itself appears to have been impervious to the solutions. In places, the solutions followed upward along planes in the sheared limestone before reaching the contact.

The ore mined from the lead *manto* in the first 10 years of production was undoubtedly selected. Assays for the first 10 years and for the year 1900 are given in the paper.

### Production

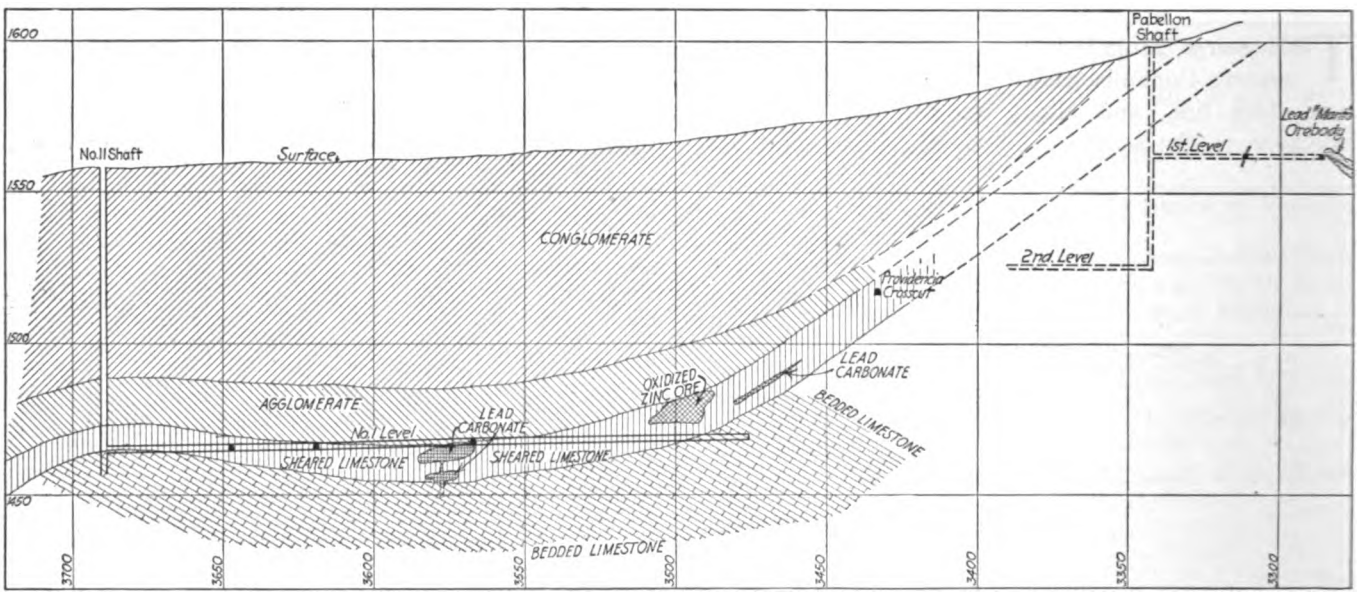
Records of production have not been carefully kept, especially during the early years. The total production of lead ore to the end of 1920 has probably been between 3,000,000 and 3,500,000 tons, and of copper and silver-lime ore, 1,500,000 to 2,000,000 tons, the combined value of which totaled between $50,000,000 and $75,000,000 (U. S. Cy.).

### Future of District

Observations at the present time lead to the conclusion that the future of the district lies in exploiting the contact ore zones, together with underlying silver-lime impregnations. It may also become profitable to mine the low-grade oxidized zinc ore, of which a large tonnage is now available in the Encantada and San Salvador mines, but this can be done profitably only after some means of concentrating the ore locally has been developed.

The extensive lead *manto*, once the principal mainstay of the camp, is practically exhausted. There appears to be no geological reason why another bed of limestone favorable for deposition of lead ore may not be found below the present worked bed, and diamond drilling could well be employed to determine this point. The migration of the silver from the extensive lead *manto* to lower points could well be investigated.

Some lead and zinc ore has been mined from local fractures in the Atalaya claim, south of the generally accepted ore limits, which leads to interesting speculation as to the existence of orebodies at some depth below the present surface, or possibly to the former existence of orebodies now eroded.




Section across zinc stope Doenea and Providencia Mines, Sierra Mojada, Coahuila.

## The British Columbia Batholith and Related Ore Deposits*

By Philip D. Wilson, Warren, Ariz.

THE Province of British Columbia covers 382,000 sq. mi., about 250,000 sq. mi. of which have not been prospected. The most important structural feature of British Columbia is the great Coast Range,

* San Francisco Meeting, September, 1922.

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which follows the Pacific Ocean a little west of north from the international boundary to the Yukon. It is almost wholly composed of coarse, granitoid rocks, which vary from gabbro to granite in composition, but are in large part granodiorite. These rocks are so closely related that the mass may be considered as one gigantic batholith, intruded during a long-continued period of igneous activity in late Jurassic and early Cretaceous times.

The mountainous belt, about 100 mi. wide, which roughly parallels the southern international boundary, has been invaded by great batholiths of plutonic rocks closely related to those of the Coast Range with their characteristic, rugged, massive topography. This rough border country gradually blends into the Plateau region of northeastern British Columbia. While the rocks of this huge series of Mesozoic intrusions rarely contain evidence of ore deposits within themselves, the invaded rocks on both borders and in the big included masses often show strong and widespread mineralization. It is in these older intruded rocks, largely sedimentaries and effusive volcanics, that most of the orebodies are found. The relation of the developed mines to this long but comparatively narrow intrusive backbone is shown in Fig. 1, on which the post-Cambrian intrusive rocks have been outlined from Bailey Willis' geologic map of North America.

The territory that shows most mineral promise is a great arc, curving from the Alberta line on the southeast, where the Rocky Mountains rise abruptly from the prairies, into the Yukon on the northwest, where it loses itself in the plateau.

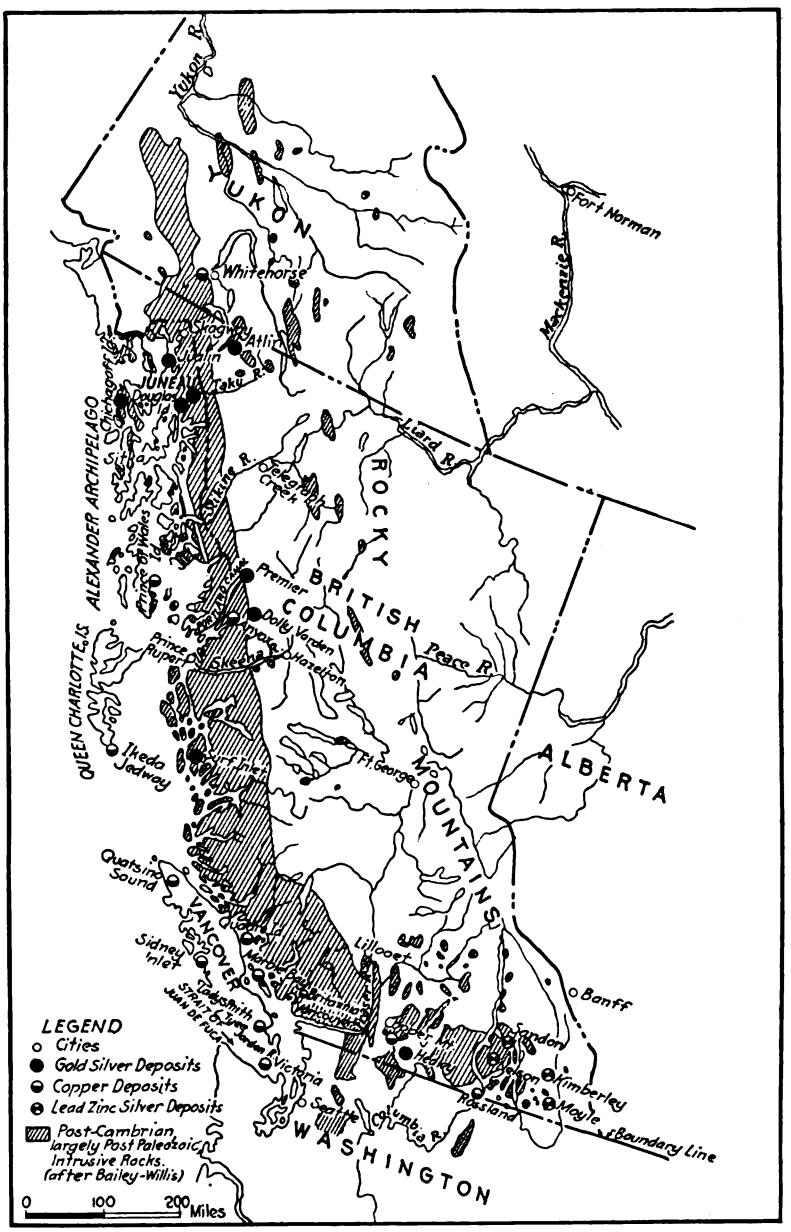


FIG. 1.—MINERAL DEPOSITS OF BRITISH COLUMBIA.

## ORE DEPOSITS IN EASTERN CONTACT BELT

There are many points of similarity between the ore occurrences in what may be called the inner contact belt of the Coast Range, of which the Alice Arm, Salmon River, and Atlin Districts are most important and may be considered typical. The Dolly Varden, Premier, and Engineer orebodies, and the showings in the neighboring prospects, are definitely associated with quartz-filled fissures, cutting the Mesozoic series of argillaceous sedimentary rocks and associated volcanics, largely andesite tuff and breccia, that lie east of the Coast Range batholith. Numerous dikes and small bodies of intrusive rock related to the batholithic intrusion invade this earlier series and the final emanations from the same dying magma are probably responsible for most of the economically important mineralization. The ores in the Dolly Varden are silver with virtually no gold; in the Premier, the value of the gold and silver production is about equal; in the Engineer, nothing but gold is found. Secondary enrichment has been important in concentrating near the surface the silver content in the two former mines. In the Dolly Varden, in particular, phenomenally rich silver, argentite and pyrargyrite ore has been mined directly beneath the thin surface layer of muskeg and glacial debris.

## ORE DEPOSITS IN WESTERN CONTACT BELT

Near Juneau, on both Douglas Island and the mainland, situated on the Pacific side of the Coast Range batholith, which at this point is about 50 mi. wide, are gold mines famous for their large-scale low-cost operations. The Alaska-Gastineau, Alaska-Juneau, and Alaska-Ebner have developed large but very low-grade

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gold-bearing deposits in a steeply dipping, mineralized, shattered zone about 200 ft. wide in graphitic slate cut by metagabbro dikes.

Across Gastineau Channel, on Douglas Island, the famous Treadwell mines have been working for almost 40 years, a similar but wider zone in which albite diorite dikes, mineralized with quartz, metallic sulfides and gold, are intrusive into black graphitic slate. The deposits are largely confined to the dike material with its network of quartz veinlets but the orebodies of commercial grade are sometimes very large. As in the Juneau deposits, selective mining is impracticable but the average grade of the Douglas Island ore has been higher than that of the mainland bodies and the mines have been very profitable. Other low-grade gold mines, such as the Jualin and the Kensington, and the smaller higher grade veins of Chichagoff and other islands, are also found in the coast belt west of the Coast Range batholith. Even more typical of the mineralization in this belt are the multitude of limestone-copper deposits of the contact metamorphic type, exemplified by the Marble Bay mine on Texada Island and several on Vancouver, Quadra, Queen Charlotte, and Prince of Wales Islands.

### Ore Deposits in Included Blocks Within Batholith

The two most important copper mines in British Columbia, the Hidden Creek at Anyox and the Britannia on Howe Sound near Vancouver, have been developed in included blocks or "roof pendants" within the Coast Range batholith. The Hidden Creek orebodies occur as great lenses at or near the contact of a large intrusive greenstone mass with highly altered slate and argillite.

The inclusion in the Coast Range batholith in which the Britannia orebodies are found is composed of black argillite with intruded sills of igneous rock, usually quartz porphyry, which conformably follow the bedding. All have been tilted to a steeply dipping position. Mineralization is confined to a strong, persistent shear zone in the quartz porphyry of what is known as the Fairview sill. The sill itself is 2500 ft. wide and the maximum width of the shear zone is close to 1000 ft. Both can be traced for 5 mi. and probably extend for an even greater distance. The developed copper orebodies are four in number and a fifth is indicated by recent work.

### Ore Deposits in Southern Border Belt

The third large copper mine of the province is that brought to the point of production in the fall of 1920 by the Canada Copper Corpn. at Copper Mountain in the Similkameen district, near Princeton. It is about 30 mi. north of the internationl boundary and 180 mi. east of Vancouver. In this district, granitoid rocks with small included masses of highly altered argillite, limestone and quartzite, are traversed by recent light-colored porphyry dikes. It is the granitoid rocks and the occasional sedimentary blocks that are mineralized. The earliest of the former is an augite-monzonite that has been invaded by great masses of granodiorite and still later by pegmatite and granite. The intrusion of the granodiorite and granite and the subsequent mineralization are probably related to the intrusion of the Coast Range batholith, which has been so productive of mineralization throughout the northwest.

At the Copper Mountain mine, eleven orebodies, lenticular in plan, have been developed by extensive diamond drilling in the central 3300 ft. of a fracture zone over 1 mi. long and, in places, nearly 1000 ft. wide. The average width of this zone is, perhaps, 200 ft. The ore lenses grade from the Sunset, which is 750 ft. long, 725 ft. deep, and 300 ft. wide, to small outlying orebodies 100 ft. long, 100 ft. deep, and 50 ft. wide. Only five lenses outcrop. The others were found by diamond drilling. The deposits grade into the walls except where porphyry dikes form one or both walls, when the line of demarcation is sharp and the contact often carries a little clay gouge. The developed ore, of which there is roughly the same tonnage as in the Hidden Creek and Britannia mines, averages about 1.74 per cent. copper and about 30 cents in recoverable gold and silver per ton.

A little over 100 mi. southeast of Princeton are the Rossland and Boundary districts, in which for many years the mines at Rossland, Phoenix and Greenwood have produced a substantial annual tonnage of copper-gold ore. The deposits at Phoenix and Greenwood are now virtually exhausted but the Rossland camp will produce for many years. The Consolidated Mining and Smelting Co. of Canada, which owns mines at Rossland and the Trail smelter, also owns the Sullivan mine, 100 mi. to the east near Kimberley in the East Kootenay District and near the boundary of the Province of Alberta. Here a large replacement deposit of silver-bearing lead-zinc ore has been developed in a great thickness of pre-Cambrian quartzites, which has been invaded by sills of gabbro.

Within this great curved zone, extending for 1500 mi. from the Alberta boundary in the southeast to beyond the Yukon line in the northwest, it is almost certain that more large mines will be found. There are great stretches along the eastern contact of the Coast Range batholith that have never been explored. With the exception of the comparatively narrow band made accessible by the navigable fiords, Portland Canal and Observatory Inlet, and the Grand Trunk Railway along the Skeena River, the inner contact from Lillooet for 800 mi. north to the Taku River may be considered virgin, almost unprospected, territory. There is also every reason to believe that other included blocks of ore-bearing rocks similar to those at Anyox and Howe Sound will be found within the great granite range. When more trails are built and the heart and eastern slopes of the mountain chain become more accessible to

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the hardy pioneer, this curving coastal backbone is sure to develop into an ever increasingly important asset to the mineral wealth of the Province and of the Dominion.

## Deposition of Copper Carbonate from Mine Water*

By Philip D. Wilson, Warren, Ariz.

THE genesis of some orebodies has been explained by the mingling and chemical interaction of water solutions of different compositions and the consequent precipitation of the mineral load of one or both solutions at their confluence. While this process can be proved in the laboratory, rarely can a positive demonstration be found in nature, for the conditions at the time an ore deposit is being worked are usually entirely different from those that existed when the orebody was formed. For this reason, the present deposition of copper carbonate in the southern end of the Briggs mine of the Calumet and Arizona Mining Co. near Bisbee, Ariz., is of great interest.

The developed orebodies in the Calumet and Arizona mines are roughly confined to two broad parallel zones. The more westerly zone includes mines that have not been operated since 1919. Much of the water from this division is carried from the 1400-ft. or bottom level at the southern end of the Cole mine in a long water drift through the undeveloped block to the 1300 ft. level of the Briggs mine at the southern end of the more easterly zone. Most of this water comes from outlying areas in the P. and D. mine, and passes through parts of the lower levels of the Cole mine that are heavily mineralized with iron and copper sulfides that have been opened up and slowly oxidizing for years. Originally a pure, potable water, on its way through the mineralized area it gathers copper, calcium, magnesium, iron, and aluminum sulfates, a load of dissolved mineral salts almost four times as great as that which it formerly carried. Its carbon dioxide has entirely disappeared, the carbonates having been changed to sulfates. While it contains no free acid and is neutral to methyl orange, it shows a decidedly acid reaction to phenol phthalein. It also has an extremely low chlorine content.

Where the mixture between this highly saline water and the fairly pure alkaline water, from an outlying and undeveloped part of the Briggs mine, takes place a bright green deposit of hydrous copper carbonate, essentially malachite in composition, is formed as a crust on the limestone in the ditch. That the reaction is almost instantaneous and quite complete is shown by the negligible percentage of copper in the residue analysis of the mixture in a sample taken close to the confluence of the two. The mixed water is carried in a drift for about 1300 ft. and then dropped through a 100-ft. raise to the level below. For this entire distance the rock in the ditch and in the raise is painted a brilliant green. An analysis of the water issuing from the foot of the raise did not show a trace of copper, but the suspended matter gave a definite qualitative test for it. The chemical reaction has apparently been completed and virtually all the copper precipitated long before the water reaches the raise. The relation between the water's capacity to carry dissolved copper and its acid or alkaline condition is clearly indicated by analyses.

* San Francisco Meeting, September, 1922.

## Surface Tension and Adsorption Phenomena in Flotation*

By Arthur F. Taggart and A. M. Gaudin

IN this paper, a form of apparatus for the measurement of surface tension at gas-liquid interfaces by the Wilhelmy method is described, and a number of surface-tension tests are presented which lead to the following conclusions:

(*a*) The members of an homologous series depress the surface tension of water in amounts that increase as the molecular weight increases and the solubility decreases.

(*b*) The concentration of solute and surface tension of the solution bear a linear relation in dilute solutions; they vary according to a logarithmic law in concentrated solutions; in solutions of intermediate concentration, the law of variation is variable and intermediate between the other two.

(*c*) The depression of surface tension due to the simultaneous addition of two or more solutes that are members of an homologous series is, in the main, the sum of the depressions caused by the individuals when present separately. This additive rule does not, necessarily, apply when the added substances are not chemical homologs.

(*d*) The addition to water of a substance (oil) insoluble therein has no effect on the surface tension of the water.

(*e*) The simultaneous addition to water of a substance (oil) insoluble therein and of another substance (oil) soluble in the water but not soluble in the first substance, produces only the effect on the surface tension of the water that would have been produced by the addition of the second substance alone.

(*f*) The simultaneous addition to water of a substance (oil) insoluble therein and of another substance (oil) soluble both in the water and in the first substance, produces an effect on the surface tension of the water less than that which would have been produced by the addition of the second substance alone. Surface tension-concentration curves for this type of mixtures change with concentration from convex to concave, indicating progressive increase in extraction of solute by the water.

(*g*) Oleic acid has but slight effect on the surface tension of water until the amount present is sufficient to and does form a mono-molecular film. Beyond this point, surface tension drops rapidly until an amount of acid equivalent to a film about one-and-a-half molecules deep is reached, when another change occurs and further addition produces again but slight effect.

(*h*) Oleic acid is a limiting case in the series of soluble substances affecting surface tension.

The relation between the solubility of an oil with its consequent effect on the surface tension of water and its effect on frothing is found to be as follows:

(*a*) The addition to water of an oil insoluble therein has no effect on the frothing power of the water.

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(*b*) The effect of the addition of members of an homologous series on the frothing power of the resultant water solution increases as the solubility of the member decreases.

(*c*) Maximum frothing effect occurs with the addition of amounts of solute about one-half of that required to saturate the solution. The point of maximum frothing is that at which the difference between the static and dynamic surface tensions of the solution is greatest.

(*d*) Emulsions in water, in which no water solute is present, do not froth.

(*e*) Emulsions of oil in water, consisting in part of mechanically dispersed oil and in part of dissolved oil, froth less than does a solution containing an equal amount of solute alone.

(*f*) The undissolved oil of an emulsion acts as a reservoir for soluble oil so that the frothing power of the emulsion is not diminished as greatly by dilution with water as would be expected were the solute present alone.

Methods of making adsorption tests are described and results of adsorption tests are presented that lead to the following conclusions:

(*a*) At saturation, the concentration of a positively adsorbed substance at the gas-liquid interface of a solution is that of a complete mono-molecular film.

(*b*) The rate of adsorption of solute increases with the concentration at a decreasing rate; this rate is greater the less the solubility of the solute.

(*c*) An oil insoluble in water, when present therein alone, will not adsorb at a water-air interface.

(*d*) Distinct concentration of soluble oil takes place in the froth in a flotation machine, with corresponding impoverishment of the water in the machine.

(*e*) Adsorption of flotation oils at solid surfaces from emulsions is not capable of measurement by the method employed.

(*f*) Soluble oils adsorb at solid surfaces in amounts of the order of mono-molecular films. The adsorption is, in general, greater by two to three times at sulfide surfaces than at gangue surfaces.

(*g*) Adsorption of flotation oils from water solution at sulfide surfaces is an irreversible phenomenon.

(*h*) The amount of adsorption of different solutes at a given surface varies with the solute.

(*i*) Molecules in adsorbed films are definitely oriented with respect to the adsorbing surface. In the case of flotation oils, the orientation is probably generally such that the hydrocarbon end of the molecule is away from the solid at solid-water interfaces, and away from the water at air-water and bulk oil-water interfaces.

(*j*) Selection of sulfide from gangue in flotation takes place by reason of the differential adsorption of flotation oils at sulfide and gangue surfaces. The difference in behavior of the coated and uncoated solid particles toward air takes place by reason of the orientation of the molecules in the adsorbed film.

(*k*) The difference in adsorbing power of sulfide and gangue minerals is one of degree only and varies with different solutes; hence by proper regulation of conditions, variations in difference in flotability between the two can be controlled.

A relation between surface-tension depression and size of mineral grain that can be floated is established in a particular case and a general relation of the type $a = K\Delta^m$ is indicated, where $a$ represents the maximum size of grain in the ore, $K$ and $m$ are constants for any given ore and reagent, and $\Delta$ is the surface-tension depression. The number $m$ has a value near $\frac{1}{2}$, and $K$ and, to a lesser extent, $m$ depend on such factors as kind of mineral, specific gravity of solid, kind of solute, thickness of bubble walls, size of bubbles, and viscosity of bubble films.

Relations between depression of surface tension and metallurgical results of a flotation operation are found to exist as follows:

(*a*) The larger the surface-tension depression at the beginning of a flotation operation, the greater the recovery and the poorer the grade of concentrate.

(*b*) The higher the recovery, the greater the possible change in surface-tension depression without resulting change in recovery.

(*c*) The finer the ore, the less the necessary depression in surface tension in order to effect a given recovery.

## Conditions of Stable Equilibrium in Iron-carbon Alloys*

By H. A. Schwartz, H. R. Payne, A. F. Gorton, M. M. Austin, Cleveland, Ohio

FROM time to time, one of the authors has had occasion to investigate the graphitizing reaction and has published the results mainly as discussion of the work of other investigators. In view, therefore, of the diversity of both observations and interpretation, it seemed well to attempt a revision of the entire subject in the Research Laboratory of the National Malleable Castings Co. The work consisted of a careful study of a single, impure, iron-carbon alloy. The material, which may be considered typical low-carbon white cast iron of the malleable industry, was an air-furnace iron of the following composition: carbon 2.30 per cent., silicon 1.20 per cent., manganese 0.29 per cent., phosphorus 0.156 per cent., sulfur 0.048 per cent. The freezing range extended from 1213° to 1132° C., the latter figure agreeing with Gontermann's data.

The authors have attempted to define the equilibrium diagram of this alloy, in the stable condition as related to the metastable diagram, from a temperature somewhat below the eutectic freezing point to a temperature below $A_{r1}$ and for a graphitic-carbon content from practically nothing to the original total carbon of the specimen. More especially they desired to locate the line in the stable diagram corresponding to the $A_{c_m}$ line of the metastable system, which is designated by analogy, the $A_{t_m}$ line ($t_m$ from temper carbon); also to determine the location of $A_{t_m}$ with respect to $A_{c_m}$ toward their lower extremities at $A_{r1}$ in order to determine whether or not graphitization is completed by the separation of an iron-carbon eutectoid analogous to pearlite in the iron-cementite system. This would involve further a comparison of the locations of the stable and metastable $A_1$ points.

As the carbon concentrations of the solid solutions of the two systems are probably not identical, an explanation of their differences and of the mechanism of their conversion into one another was to be sought. The experimental methods of attack included the following:

1. Determination of thermal critical points of stable and metastable alloys.

* San Francisco Meeting, September, 1922.

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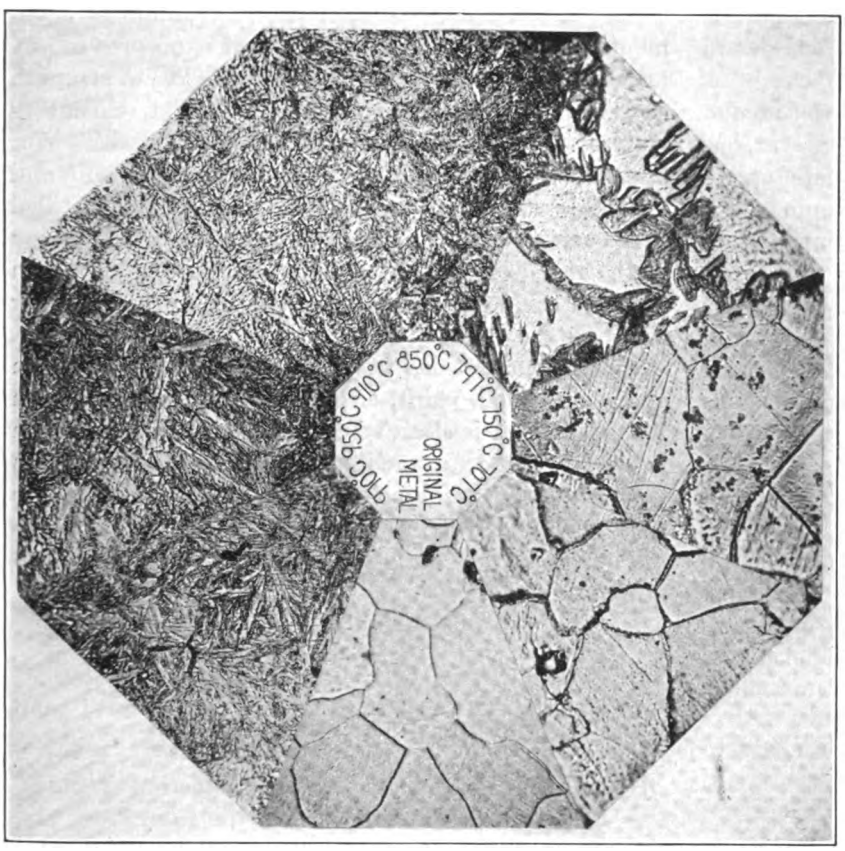
2. Microscopic study of solid solutions of the two systems.
3. Chemical investigation of solubility of carbon in stable system, as related to temperature.
4. Study of changes in electrical resistance accompanying graphitization.
5. A few scattering observations incidental to other work that have a bearing on this problem.
6. Preparation and examination of a series of alloys varying progressively in carbon and having otherwise the composition of the hard iron to serve as a means of defining the location of $A_{c_m}$, or at least its terminus at $A_1$.

The conclusion is reached that the stable and metastable solid solutions are metallographically distinct from one another. The photomicrographs indicate that $A_{C1}$ metastable is below and $A_{c1}$ stable above 750° C., *i.e.* that the stable critical point is above not below the metastable.




STRUCTURE OF MALLEABLE CAST IRON QUENCHED FROM VARIOUS TEMPERATURES. ETCHED WITH ALCOHOLIC $HNO_3$. × 1000, REDUCED ONE HALF IN REPRODUCTION.

The authors believe that the study of electrical resistance as an expression of the graphitizing reaction is novel. It is a most useful means of checking conclusions based on other methods for determining critical points, differentiating between various solid solutions and investigating the mechanism of graphitization.

Changes of resistance during the process of graphitization at constant temperature were observed; success in this experiment is possible only if great uniformity of temperature with respect to time and throughout the specimen can be attained. These precautions being taken and stray thermal electromotive forces eliminated, changes of resistance with time were observed and plotted.

In the microscopic examination of many specimens of hard iron in which graphitization is just beginning, it was observed that the first evidence of the formation of temper carbon is never entirely within a cementite grain, is very rarely in contact with a cementite grain, and is usually entirely within the austenite (mix crystal). Phillips and Davenport present micrographic evidence to this effect. The authors, in common with others, have frequently observed that when graphitization proceeds below $A_1$, the temper carbon is entirely surrounded by ferrite. It is common knowledge that the distribution of temper carbon in malleable iron in no way suggests the dendritic structure of the original hard iron.

The conclusion is reached that the solid solutions of the stable system are distinct in structure, electrical properties, and temperature-solubility relation from those of the metastable system. For this new stable solid solution, the authors propose the name boydenite, in commemoration of the metallurgist who first practiced the graphitizing reaction.

## Effect of Impurities on the Oxidation and Swelling of Zinc-aluminum Alloys*

BY H. E. BRAUER AND W. M. PEIRCE

AMONG the zinc base alloys used for casting in metal molds, particularly die casting, those alloys containing aluminum, usually together with copper, are probably the most widely used. The reason lies in their desirable mechanical properties and the fluidity and absence of hot shortness which facilitate casting.

Objection to the use of these alloys may be raised on account of the rather frequent instances of failure of a type variously described as disintegration, exfoliation and intercrystalline corrosion. The alloys described in all such cases contain impurities or alloying metals which the present authors have found to have enormous accelerating effects on intercrystalline oxidation in zinc-aluminum alloys.

No thorough investigation of the nature and cause of this type of failure has been made heretofore, so far as the authors are aware, although Rawdon correctly classified it as internal oxidation.

This investigation was made to determine the exact nature of this phenomenon and the effect of other metals present as impurities or intentional additions in accelerating or retarding it. The appendix contains

* Rochester Meeting, June, 1922.

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a considerable amount of data which may be valuable in selecting an alloy combining good physical properties with high resistance to oxidation.

In investigating pure zinc-aluminum alloys, it was found that the type of failure under discussion is due to intercrystalline oxidation which attacks $\alpha$ but not $\gamma$.

When the $\beta$ constituent is decomposed into $\alpha$ and $\gamma$, the resulting structure offers an enormous number of secondary grain boundaries in which oxidation can occur.

Expansion measurements show that quenching from above the decomposition temperature of $\beta$ increases the expansion. This may be due to the fact that some undecomposed $\beta$ remains and is especially susceptible to oxidation or it may be due to a finer particle size in the decomposed $\beta$ or to both.

This oxidation occurs at a rapid rate in wet steam. Six months' exposure in dry air at 100° C., however, has produced no attack. Moisture appears, therefore, to be essential. The grain size of zinc-aluminum alloys decreases with increasing aluminum content and in coarse-grained alloys (alloys below two per cent. aluminum) the depth of penetration is great though the expansion may be slight.

The severity of intercrystalline oxidation as affecting the physical characteristics of a specimen depends upon the grain size and the presence or absence of impurities, or other metals added in the alloy.

In the investigation of zinc-aluminum alloys containing other metals, it was found that certain metals when present even in hundredths of a per cent. accelerate the oxidation noticeably. Lead is the most powerful accelerator. Cadmium and tin are nearly as effective. Iron is somewhat less active. Nickel and manganese when present alone in zinc-aluminum alloys are moderately detrimental.

Copper to the extent of 0.5 per cent. is a powerful retarding agent and in any amount up to 5 per cent. is more or less beneficial.

In dense castings of fine-grained alloys free from detrimental impurities the rate of penetration is very small and uniform resulting in a slight expansion without distortion. The density of the castings, however, is of prime importance, and in die castings the effect due to differences in soundness of the castings of various alloys may equal the effects due directly to the composition.

In zinc-aluminum alloys containing detrimental impurities, the depth of penetration and the expansion are very pronounced and result in great distortion. The percentage of lead and cadmium in any but the highest grade zinc is sufficient to cause this effect and many commercial alloys of this type contain considerable tin which is an accelerator.

While in chill cast alloys and alloys quenched from above 256° C., the amount of expansion increases with increasing aluminum up to 21 per cent., the effect of impurities may entirely overshadow this.

Thus an alloy containing only 0.5 per cent. aluminum together with 7 per cent. tin and 3.75 per cent. copper has expanded as much after 15 days in steam as a 4 per cent. zinc-aluminum alloy containing no added metals and corrosion has penetrated deeper. On the other hand, an alloy containing 0.5 per cent. copper and 10 per cent. aluminum expands no more in 15 days than a 0.10 per cent. zinc-aluminum alloy containing no added metal.

The rate of penetration and expansion decreases as the depth of penetration increases in the case of fine-grained alloys free from harmful impurities.

It is the belief of the writers that zinc-aluminum-copper alloys, free from appreciable amounts of detrimental impurities, will withstand long exposures to any natural atmosphere with no appreciable loss of strength and with only slight expansion, and that, except in tropical climates, no appreciable expansion will occur, also that the alloy containing 5 per cent. aluminum and 2.5–3 per cent. copper made with a high-grade distilled zinc constitutes a very great improvement over many of the zinc-base alloys made with impure zinc now in use, and consequently should open up a wider field for zinc-base die castings.

While the question of protection of these alloys from oxidation by oil, paint, enamel, etc., has not yet been investigated, it is clear, of course, that a coating which helps to exclude oxygen must offer some protection from the intercrystalline oxidation which causes failure of these alloys.

The paper is replete with curves and photomicrographs.

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## Safety Code for Foundries

ADEQUATE provision for the protection of industrial workers in foundries in the iron, steel, tin, zinc, lead, aluminum, and other industries is included in the National Safety Code for the Protection of Industrial Workers in Foundries which has just been approved by the American Engineering Standards Committee.

This code is a revision of that developed by the American Foundrymen's Association and the National Founders Association, joint sponsors of the new code, and was worked out by a thoroughly representative sectional committee under the auspices and procedure of the American Engineering Standards Committee.

The approved code deals with foundry conditions only, omitting such subjects as building construction. It consists of 124 sections which are grouped under the following 12 main divisions: entrances, floors, pits and galleries, gangways, aisles, foundry equipment, finishing and cleaning, heating, ventilating, operating rules, protection devices, employment of females, and recommendations.

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# Personal Notes and Biographies

**James D. Kerr** is with the U. S. Gypsum Co., Plasterco, Va.

**J. H. Rose** is with the Braden Copper Co., at Rancagua, Chile.

**B. E. Hammer** is with the Braden Copper Co., Rancagua, Chile.

**William H. Hubbard, Jr.** is at Laurel Hill, N. Y., with the Nicholas Copper Co.

**Martin F. Tynan** is with the Braden Copper Co., Sewell, Chile, South America.

**Norman D. Lindsley** is with the Moctezuma Copper Co., at Pilares de Nacozari, Sonora, Mex.

**J. Walter Atlee** has accepted a position with the North Carolina State Highway Dept., at Ledger, N. C.

**Irving A. Chapman** has become a partner in the firm of Williams, Nicholas & Moran, New York City.

**Lawrence R. Clapp** is with the Granby Mining, Smelting & Power Co., at Anyox, B. C., Canada.

**William C. Fox** is chief chemist and metallurgist for the Mansfield Sheet & Tin Plate Co., Mansfield, Ohio.

**E. K. Soper,** manager of the Trinidad Tarouba Oil Development Co., has returned to New York from Trinidad.

**Robert Hursh,** recently with the Empire Zinc Co. at Denver, Colo., has gone to San Francisco, Cal., for the New Jersey Zinc Sales Co.

**Everett Carpenter,** consulting geologist of Winfield, Kansas, who has undergone two major operations since March 1, is able to resume his work.

**Ernest O. Blades** recently was appointed superintendent of the Republic properties being operated by the Balaklala Cons. Copper Co. at Republic, Wash.

**Spruille Braden** of the Braden Copper Co., Chile, and Mrs. Braden, were among the passengers arriving on the S. S. "Southern Cross" which reached New York on July 11.

**W. Z. Miller,** who has been with the Gulf interests for the last seven years, doing geological work in Oklahoma and Kansas, and parts of South America, recently resigned his position. Mr. Miller and Carl D. Smith have opened an office for consulting work, at 447 Kennedy Bldg., Tulsa, Okla.

**V. R. Garfias,** manager of foreign oil companies of Henry L. Doherty & Co,, has returned to New York after an extensive tour of investigation of the European and foreign producing and prospective oil fields. He was in Rapallo the day the Russian-German treaty was signed and followed closely the negotiations between the oil groups and the Russian representatives in connection with the obtaining of Russian oil concessions.

**W. L. Saunders** was a guest at a garden party given by the King and Queen of England, at Buckingham Palace, on July 21. According to cable dispatch to the *New York Times*, the Duke of Atholl, the Lord Chamberlain, presented Mr. Saunders to the King as his Majesty moved among his guests, mentioning Mr. Saunders' connection with the Naval Consulting Board. In his conversation with Mr. Saunders, the King said that means of preventing rather than of making war are what are most wanting nowadays, and he is confident that the American people will do all in their power in that direction, particularly by exerting the nation's great moral influence in the world.

Mr. Saunders was much impressed by the democratic simplicity with which the King and Queen moved about among their guests, stopping to chat informally with their friends.

**F. W. McNair,** president of the Michigan College of Mines, has accepted appointment by the Society for the Promotion of Engineering Education as one of its representatives on a joint committee composed of members of the society and of the National Industrial Conference Board, which is planning to take up the general problem of engineering training for the industries.

Among those who have already accepted the invitation of the board to serve on behalf of industry are: Frederick P. Fish, lawyer of Boston, and formerly president of the American Bell Telephone Co., and American Telephone and Telegraph Co.; E. M. Herr, president of the Westinghouse Air Brake Co., of the Westinghouse Electric and Manufacturing Co., and director of many other large electrical concerns; Henry D. Sharpe, treasurer of the Brown and Sharpe Manufacturing Co. and D. W. H. Nichols, manufacturing chemist, former president of the General Chemical Co., chairman of the committee on chemicals of the Council of National Defense, and now director of many chemical enterprises. Other educators will be chosen from technical schools of the country to represent the society.

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## John A. Bensel

JOHN ANDERSON BENSEL died on June 19, at his home in Bernardsville, N J., after an illness of several months.

Mr. Bensel was born in New York City in 1863, graduated from Stevens Institute in 1884, and gained a practical knowledge of his profession as rodman for the New York Aqueduct and the Pennsylvania Railroad. After several years as assistant engineer for the docks and terminals of that railroad and later with the New York Dock Department, he spent six years, from 1889 to 1895, in charge of construction on the North River waterfront. He was appointed chief engineer and commissioner of the Dock Department, and in 1911 was made state engineer of New York. At the time of his death he was a member of the Board of New York Water Supply, and a consulting engineer for the New York and New Jersey Vehicular Tunnel Commission.

During the war Mr. Bensel was in the army and, as Major, commanded the 125th Battalion of Engineers.

## Anders Richard Akerman

ANDERS RICHARD AKERMAN, honorary member of the Institute, died on Feb. 23, 1922, after a long and distinguished career. He was born April 18, 1838, in Stockholm, where his father was a professor at the Technical University, but the greater part of his childhood was spent in Falun, where the family moved after his father was made principal of the mining academy. He was at first taught by a tutor, but in 1851 entered the high school in Vesteras and the University of Uppsala, 1855, from which he graduated as a mining engineer on Dec. 11, 1860. A week later, he entered the mining academy at Falun, from which he graduated Dec. 15, 1862. The following May, he was accepted as a student in the metallurgical section of "Jernkontoret" (the "Iron Institute") and on Oct. 22, 1864, he was made an assistant in the same section.

His connection with the Jernkontoret continued throughout his life, as teacher, editor, and writer. For thirteen years he was chief of the Bureau of Commerce, and in other ways served his Government.

A more extended biography, prepared by J. A. Leffler, is printed in Vol. LXVII of the Institutes' TRANSACTIONS, in which are enumerated some of Professor Akerman's writings and the many honors that were bestowed upon him.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month June 15 to July 15, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1915 | BENSEL, J. A | June 19, 1922 |
| 1899 | KIRKCALDY, N. M | |
| 1899 | LAWRENCE, SCHUYLER | Jan. 9, 1922 |
| 1883 | MILLS, FRANK P. | May 18, 1922 |
| 1921 | VAN EVERA, EDWARD | May 1, 1922 |

# Correspondence and Discussion

## Oil and Gas Education

I HAVE been looking over the report of the committee on education, Oil and Gas Section of the Institute, published on page 25 of the June issue of MINING AND METALLURGY, and find that the statement with regard to the University of Kansas is quite erroneous.

Our catalog shows the following courses of which the names show their relation to the oil and gas industry:

| | Credit | Hours |
|---|---|---|
| Economic geology, oil, gas and other non-metals. | 5 | 90 |
| Petroleum fields of the world—North America.. | 5 | 90 |
| Petroleum fields of the world—other continents. | 5 | 90 |
| Gas analysis | 2 | 36 |
| Oil analysis | 2 | 36 |
| | | 342 |

Other courses, not bearing the name of oil or gas but dealing largely with these subjects, are included in the courses of students fitting themselves for work in the oil and gas fields.

| | Credit | Hours |
|---|---|---|
| Field geology | 2 | 36 |
| Structural and dynamic geology | 3 | 54 |
| Principles of sub-surface geology | 3 | 54 |
| Elements of mining | 3 | 54 |
| | | 198 |

This shows that the University of Kansas offers 342 hours of courses indicating their connection with oil and gas by name, and an additional 198 in subjects closely related with these, thus having a total of 540 hours of work closely connected with the petroleum industry instead of the 90 hours shown in the list published by the committee.

C. M. YOUNG,
Professor Mining Engineering.

Lawrence, Kansas, June 14, 1922.

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# Institute Affairs

## Closing Date for Papers

THIS early announcement is made that Dec. 1 will be the closing date for papers for the annual meeting in February.

Papers must be in the hands of the Secretary before that date in order to insure publication and distribution before the meeting, which is the only means of getting the proper amount of discussion of papers and the problems they contain.

It not only contributes to the success of the meeting but helps to reduce the pressure on the Secretary's office, and reduce costs, when papers are received early, so that with sufficient notice it is to the advantage of everybody, including the author, to get these papers in on time.

## Employment Service

AS noted in the July issue of MINING AND METALLURGY, the Federated American Engineering Societies on July 1 returned the Employment Service Bureau to the care of the secretaries of the four national societies. This was done for the reasons stated in the resolutions passed by the Federated at the May meeting. For the remainder of the year, the Employment Service will be operated substantially as it has been in the past except that other organizations will probably not participate in it.

Through its broadcasting of lists of positions available and of engineers wanted, there has been an attempt to make the service national in scope, and this has been successful to a limited extent, but admittedly not so successful as though paid office forces were maintained in all of the larger cities for collecting and distributing information. The expense of maintaining a number of offices is beyond the means of the interested societies, especially when neither the employer nor employee contributes toward the support of such offices.

Naturally, this suggested the advisability of converting the bureau of information into a paid service of a wider range of usefulness. The subject was given careful consideration by officers of the societies and by the volunteer committees of the men searching for positions. It was the unanimous conclusion that the avoidance of the commercial aspect of a paid service was the most valuable asset of the present service and that every effort should be made to operate without commissions. The tax on members for operating the bureau has been between 2 and 3 per cent. of their dues; opinions may differ as to whether it has been worth while or not, but we know that from Jan. 1, 1921, to July 1, 1922, 2576 men were placed by the bureau, and probably many more positions have been filled of which no advice was sent to this office.

Some of our distant members have felt that the service was strictly a New York service and that they could not benefit because of their distance from headquarters, but the number of men outside of New York who have benefited by the service proves that this assumption is not correct, though it is admitted that the man who is close to headquarters has an advantage.

That all distant members have not felt that it was strictly a local service is illustrated by the following letter of appreciation from Ohio.

> Some weeks ago, Mr. Brown put my card in the "Men Available" list of the A. S. M. E. *News*. As a result, I began work last month with a company here. I am enclosing herewith postal order for $10 to be credited to Mr. Brown's department, the Employment Bureau. This is a slight token of my appreciation of his services, and in the hope that it will aid to the extent of getting some other fellow a job. A telegram or other item within its limits may turn the scale.
>
> There is a lesson in the transaction. I received but the one reply to my card, but that was just as good as a thousand. It is the opportunities a man seizes that count; not the opportunities that open to him.

How have mining engineers fared? That is a difficult question to answer. There have been fewer openings offered for mining engineers than for others, yet these other positions have been thrown open to mining engineers through our coöperating plan, and many of our men have found needed temporary or permanent employment. It is safe to say that the miners have profited to a greater extent by the joint bureau than would have been possible by the older independent service.

## Possibilities of Engineering Societies Library

THE policy of the library is to develop the work soundly, to keep its activities within the available funds and to strive for quality before quantity. In the face of the many things that are crying to be done, this is difficult. There are many directions in which the library could be made more useful, if its resources would permit.

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One question is the lending of books. Originally intended for reference use only, there is a constant demand that books be lent, and the time is approaching when the question of policy regarding loans should be considered carefully.

There are a number of objections to lending any and every volume in the library. One is the danger of loss, another the ineffectiveness of searches if much of the material is absent from the shelves. These objections disappear, however, if loans are restricted to certain classes of books and if some books are duplicated.

Probably the best solution would be to duplicate the more important standard works and to lend these duplicate copies. If sufficient duplicates could be obtained, branch libraries might be organized in places where local sections of the Founder Societies exist, each containing the books in frequent demand. Unusual calls and those from members not connected with a local section could be met from the central collection.

Such an organization would resemble the branch library systems so common in American cities. It presents no special difficulties in administration and would be a great benefit to the whole membership. The cost would not be excessive and the plan offers a great opportunity to some philanthropist interested in advancing American engineering and industry. As a beginning, the director was authorized this year to lend duplicate books. The useful material is being weeded from the available duplicates, and loans will be made whenever possible.

Another possible utilization of the library is to prepare and publish guides to engineering literature. The need of these has been painfully apparent in recent years, when so many engineers have been required to familiarize themselves quickly with new lines of work.

All publications should be indexed and classified as soon as published, and a master catalog be compiled. This information should be published at frequent intervals, so that engineers could be informed of new developments. Bibliographies directing the student to the really important material should also be prepared and disseminated. Much of this work is being done today by institutions and individuals, but it is all fragmentary; nowhere does the whole record exist. Some agency should collect this scattered work, arrange it by some uniform plan and fill in the gaps. The work would be expensive, but would undoubtedly cost less than is now spent in searches for the material that such an agency could supply at a low cost.

The library staff prepares the Mining and Metallurgical Index published by the American Institute of Mining and Metallurgical Engineers, and assists the American Society of Mechanical Engineers to compile the Engineering Index. It has prepared annotated monthly lists of new books, which have been published by all the Founder Societies, and it has prepared a few bibliographies thorough enough to be of general value and interest.

## Summary of Minutes of Meeting of Directors, June 23, 1922

AT THE meeting of the directors held June 23, 1922, there were present 11 directors, the secretary and assistant secretary of the Institute, and six invited guests.

The minutes of the meeting of the joint committee consisting of members of the Executive, Finance, and Papers and Publications Committees, held May 31, were approved. The report of the treasurer and Finance Committee was approved.

The directors authorized some minor transfers of the funds and consequent alteration of the Budget for the remainder of the year.

The investment of $2000 Life Membership Funds in Canadian Government 5 per cent. bonds, 1952, at par and accrued interest, was unanimously approved.

Seventeen members, three Associates, and thirty Junior Associates were elected to membership. The status of three Associates was changed to Member, one Junior Associate to Member; six Junior Associates to Associates. Three members were reinstated and seven resignations were accepted.

The following representatives on American Engineering Council were elected to fill the vacancies occurring Jan. 1, 1923, each for a term of two years: J. Parke Channing, Charles W. Goodale, Galen H. Clevenger, Charles H. MacDowell.

The secretary was instructed to assume his proportion of such duties as pertain to carrying on the activities of Engineering Societies Employment Service, in substantially the same manner as heretofore conducted, this service being turned over to the Founder Societies on July 1, 1922, by F. A. E. S.

The president of A. I. M. E. was authorized to appoint an alternate upon notification of the inability of any duly elected representative to attend a meeting of the Executive Board of American Engineering Council.

An appropriation of $200 was granted to the Montana Section.

A suggested letter to be sent out by the Mining Methods Committee to some of the mining companies was approved.

The admission of Panama Canal to membership in American Engineering Standards Committee was unanimously approved.

Petitions for books to be sent to Moscow Academic Center and the Council for Research in the Kuban Territory were referred to the secretary with power.

A letter from W. M. Corse, addressed to the Finance Committee, asking that the 1923 Budget of A. I. M. E. contain an item to cover transcript of minutes of the spring meeting of the Institute of Metals Division, was referred to the Executive Committee with power.

President Dwight announced the appointment, at the request of Herbert Hoover, Secretary of Commerce, of a special coal committee of which Edwin Ludlow is chairman. This action was approved.

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# Local Sections and Affiliations

## San Francisco Section Protests Against Licensing

THE status of the movement toward licensing of engineers was discussed by the San Francisco Section at its meeting on June 13.

R. P. McLaughlin presented a paper offering arguments both for and against the licensing of engineers. He gave a résumé of the work done by the different engineering societies. His paper was followed by general discussion.

R. M. Hursh, formerly chairman of the Colorado Section, spoke of the law now on the statute books in Colorado and told some of the results of the application of that law.

After the matter had been discussed at some length, the following resolution was passed:

WHEREAS the licensing and registration laws enacted in twenty or more states have not as yet been generally approved by engineers.

AND WHEREAS the opinion of engineers is divided as to the practicability of these laws.

THEREFORE BE IT RESOLVED that the San Franciso Section of the Institute of Mining and Metallurgical Engineers hereby protests the passage of such licensing and registration laws.

A meeting of the section was held at the Engineers' Club, San Francisco, on July 11. Ex-chairman Corey C. Brayton presided.

F. W. Bradley, chairman of the General Arrangements Committee for the Fall Meeting, reported on the progress made by the committee. O. C. Ralston reported on his recent meeting with the directors in New York.

F. C. Merritt, the speaker of the evening, read a paper on Core Drilling in California Oil Wells. To those who have not been in close contact with the work being done, the progress that has been made in this new development of the oil industry was a great surprise. The speaker made the subject interesting to every one present and the discussion which followed was intensely interesting. (See page 21.)

## Philadelphia Section Officers

THE Philadelphia Section recently elected the following officers: Henry S. Drinker, chairman; Richard Peters, Jr., 1st vice-chairman; T. Mitchall Chance, 2nd vice-chairman; F. Lynwood Garrison, secretary-treasurer; Charles Enzian, assistant secretary-treasurer. The other members of the executive committee are: H. M. Chance, A. A. Stevenson, E. W. Parker, G. H. Clamer, L. H. Taylor, Jr., Morris Williams, S. E. Fairchild, Jr., Franklin Bache, W. W. Hearne, W. C. Neilson.

## Affiliated Student Societies

**University of Pittsburgh.**—The Senior mining students, in charge of Prof. Robert M. Black, this year spent their two weeks in underground surveying at a mine not previously used by the university, the French Creek iron mine of the E. & G. Brooke Iron Co., at St. Peters, Pa., near Philadelphia. This is believed to be the oldest mine now open in the United States, having been started about 200 years ago, abandoned for a long period and recently reopened. The mine and surroundings are much like those of the West.

It is unusual that opportunity is given to work under conditions that are almost those of a pioneer in exploring again workings that have been so long untouched, and in addition to the customary practice in use of instruments, a number of problems of a practical nature were solved during the two weeks stay. The superintendent, engineer and employees of the company gave the fullest possible coöperation to the party, which helped to make the work simpler and more pleasant.—*The Pitt Weekly.*

## American Engineering Societies in Argentina

EARLY in 1921, at the suggestion of the secretary of the American Society of Mechanical Engineers, Messrs. Wallace R. Lee and George S. Brady, members of the society, called a meeting of the members of the Mechanical Engineering Society in Buenos Aires for the purpose of considering the formation of a local branch of the American Society of Mechanical Engineers. Seven members were present at the meeting, which was held in the office of the American Commercial Attaché.

It was determined that it was impractical to form a local branch of the A. S. M. E. but that an organization composed of members of all the American engineering societies might be of advantage to the respective societies and to the individual members in Argentina.

At a dinner on May 30, 1921, at which were present 23 men representing seven American engineering

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societies, the new organization was formed. A constitution, based on that of the Cuban Association of American Engineering Societies, was adopted. Membership was limited to members in good standing in the various national engineering societies in the United States. The officers elected for the first year were: president, Wallace R. Lee, A. S. M. E.; vice-president, William A. Reece, A. I. E. E.; secretary, George S. Brady, A. S. M. E.; treasurer, James M. Barker, A. S. C. E. Later, A. B. Lea, A. S. C. E. and R. F. Apeseche, A. I. E. E. were nominated for the Board of Directors. During the year four meetings of the Board of Directors, four regular meetings and three special meetings were held. It is the desire of the Association to coöperate in every way possible with Argentine engineers in order to bring about a closer union between the engineering professions of the two countries.

Officers elected on May 8, 1922, are: president, Alan B. Lea, A. S. C. E.; vice-president, James M. Barker, A. S. C. E.; secretary, Henry W. Foulds, A. S. M. E.; treasurer, Robert Burns, A. S. M. E.; member of Board, William A. Reece, A. I. E. E.

# Government Action of Interest to Engineers

## Extracts from Weekly Bulletin Issued by American Engineering Council

JULY 6, 1922

**Oil Companies Investigation.**—The beginning of the investigation into the oil industry and its business methods was started by the Senate Manufactures Committee July 3 when they directed a detailed questionnaire to every company. This investigation was started under Senate Resolution and will cover financial schedules for the oil industry, special reports on organizations and business of companies, and price schedules for the period Jan. 1, 1920 to June 30, 1922. A special inquiry into the stock holdings of oil companies, calling for names, addresses and amount of stock to every stockholder will be made. Trusteeships and voting trusts, loans and borrowings also are required, together with statement of the fixed and current assets, investments, returns from affiliated companies, pipe line and refining plant values, dividends paid, and a mass of other information.

JUNE 23, 1922

**American Construction Council** was formally launched as a result of a two-day organization meeting held in Washington on June 19 and 20. The meeting was attended by about 170 representatives of the groups concerned with construction. Mr. Hoover opened the meeting with a characteristically pointed and illuminating address. This was followed by instructive addresses by Mr. Booth of the Guaranty Trust Co. of New York, by Mr. E. J. Mehren. Messrs. Townley and McClellan delivered brief addresses and otherwise participated in the conference. Mr. Townley stated that the Executive Board of the Federated American Engineering Societies had voted an expression of cordiality and coöperation. The keynote thought of each address was the great need for the formation of some agency that would have as its chief function the removal from the construction industry the many ills that it now possesses. The newly elected Executive Board is to meet with Mr. Roosevelt this week for the purpose of electing the officers of the Council. The program committee submitted the following as the lines of activity to be undertaken by the Council. These recommendations were adopted by the conference: (1) The formation of a code of ethics acceptable to the whole industry and to the public; (2) gathering of adequate statistics from all sources; (3) reduction of the national shortage of building trade mechanics and the establishment of the necessary apprenticeship system; (4) coöperation in establishing uniform building codes throughout the country; (5) coöperation with railways in expediting the revision of existing freight rates on construction materials; (6) the establishing and strengthening of local organizations throughout the country to bring about the coöperation of all elements in conformity with the principles of the Council; (7) the investigation of the evils of seasonal employment and migration of labor; (8) the encouragement of local building shows; (9) simplification and the elimination of waste; (10) education of the public as to the desirability of a better distribution of its construction and maintenance requirements; (11) promotion of health and safety for workmen and the reduction of loss of life; (12) the reduction of waste of construction materials from preventable fires; (13) the study of old buildings in order to establish superior methods of construction; (14) the education of the public as to the necessity and economy of properly maintaining structures.

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### Reports and Announcements Issued June 23–July 14

**Interior Department.** *Bureau of Mines.*—Refinery statistics for April.—Output of refineries in the United States for April, 1922.—Design and operation of a low pressure absorption plant, Technical Paper 263.—Additions, removals, and changes in permissible list of explosives from March 15 to May 31, inc. 1922, Serial No. 2362.—Explosives used in April, 1922, Serial No. 2369.—Official approval of Burrell Methane Indicator, Serial No. 2367.—Ignition of coal dust by electric arcs, Serial No. 2365.—Properties of typical crude oils from the producing fields of Oklahoma, Serial No. 2364.—The Spring Canyon Mine Rescue Association, Serial No. 2361.—Additions, removals, and changes in permissible list of explosives from March 15 to May 31, inc. 1922.—Temperature pressure curves of petroleum products.—Fatalities at coal mines in May, 1922. Helium, Serial No. 2363.—Quarry accidents in the United States during the calendar year 1920, Technical Paper 295.—Accidents at metallurgical works in the United States during the calendar year 1920.—Methods for testing petroleum products, by the Interdepartmental Petroleum Specifications Committee, 1922, Technical Paper 298.—Oklahoma promotes safety in coal mines, Serial No. 2366.

*Geological Survey.*—Production of bituminous coal, anthracite and beehive coke for week ending June 17. Mine production of gold, silver, copper, and lead in Arizona in 1921, by counties.—Production of natural sodium compounds and borates in 1921.—Mine production of gold, silver, copper, lead, and zinc in California in 1921.—Production of bituminous coal, anthracite and beehive coke for week ending June 24.—Report of work of Rocky Mountain Petroleum Association.—Production of bituminous coal, anthracite and beehive coke for week ending July 1.—Production of electric power and consumption of fuel by public utility power plants in the United States for January to June, 1922.—Mine production of gold, silver, copper, lead and zinc in Montana in 1921, by counties.—Production of bituminous coal, anthracite and beehive coke for week ending July 8.—Statistics of petroleum for May, 1922, and preceding months.

*Statements.*—Statistics of mine haulage and cutting machinery.—Radio suggested as adaptable to mine rescue work.—Sulfur dioxide leaching.—Permissible motors for use in coal mines.—Mine subsidence investigation.—Mine safety efforts of State governments.—Competition of Indian mica.—Products of combustion of gas stoves.—Characteristics of Oklahoma crude oils.—Indicator for mine gases and petroleum vapors.—Efficiency tests of government automobile engines.—First-aid work in various metal-mining fields.

### Bills Introduced June 15–July 12

S. 3730.—To provide for the filing of mineral claims in land offices of the United States (with accompanying papers); to the Committee on Public Lands and Surveys.—Mr. Kendrick.

H. J. Res. 362.—Authorizing and directing the President to take over and operate the coal mines for the period of one year, or so long thereafter as, in his discretion, may be necessary for the public good; to the Committee on Mines and Mining.—Mr. Burke.

H. R. 12233.—To authorize the Secretary of the Interior to grant permits or leases to certain persons and corporations for lands and oil and gas deposits south of the medial line of the main channel of Red River, Oklahoma; to the Committee on the Public Lands.—Mr. Sinnott.

H. R. 12237.—To limit immigration of aliens into the United States; to the Committee on Immigration and Naturalization.—Mr. Johnson.

H. J. Res. 363.—Providing for the appointment of a joint committee of Congress to investigate the causes of the strike of the coal miners in the United States; to the Committee on Labor.—Mr. Fish.

H. J. Res. 170.—To approve the holding of a national and international exhibition in the City of Philadelphia in 1926 upon the Fairmount Park and parkway site selected by the Sesquicentennial Exhibition Association, and lands contiguous thereto that may be acquired for that purpose, as an appropriate celebration of the one hundred and fiftieth anniversary of the signing of the Declaration of Independence, reported it without amendment.—Mr. Lodge.

## Investigation by the Bureau of Mines*

**Performance of Fan-Pipe Installations in Metal Mines** (Serial No. 2320). By D. Harrington and G. E. McElroy.—The use of small electrically-driven fans, in conjunction with air-pipe of various diameters, is becoming of increasing importance for the ventilation of working places in metal mines through which the general ventilating currents can not be coursed.

Detailed data on about fifty installations in three large mining districts have been collected.

**Soapstone** (Serial No. 2327). By Raymond B. Ladoo.—Brief data on composition and physical properties, occurrence, production, mining and milling, and utilization.

**Use of Low-Pressure Gas Burners in Oil-Field Boilers** (Serial No. 2329). By M. P. Youker.—The Bureau of Mines in coöperation with the Osage Oil and Gas Lessees Association of Oklahoma and the Osage Indian Agency has investigated the possibilities of using low-pressure gas in oil-field boilers to generate steam for drilling purposes. This paper gives a résumé of the report prepared by G. S. Brewer, M. P. Youker and C. E. Beecher, and printed by the Mid-Continent Oil and Gas Association of Tulsa, Okla., in its year book for 1921.

* Reports in full may be obtained from the Director of Bureau of Mines, Washington, D. C. Give serial number.

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**Conditions in the Feldspar Industry** (Serial No. 2311). By Raymond B. Ladoo.—The outstanding features of the feldspar industry are: Many grinding companies do not own or control all or even a major part of their sources of crude material, but buy in job lots from many sources. Out of date, inefficient methods and equipment for mining and grinding are in common use. Little or no coöperation exists between feldspar producers.

The small size of many feldspar deposits precludes maintenance of an efficient organization at each individual mine. Many of the best deposits of feldspar situated close to railroads are becoming depleted, which results in gradual lowering of grades, and increase in cost for better grades.

There is a lack of exact knowledge of the ceramic properties and behavior of feldspar by some consumers.

The grinding capacity of the country greatly exceeds the consuming capacity.

Uniform tests, specifications and standards of quality and fineness for different uses are needed; also standard definitions of grades.

# Increase of Membership Department

**Total membership as of July 8 1922, is 10,123**

APPLICATIONS FOR MEMBERSHIP.—**The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.**

The following persons have been proposed during the period June 15 to July 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—Byron Gray Best,** Ironwood, Mich.
Present position—1920 to date: Mining Engineer, Pabst Mine, Oliver Iron Mining Co.
Proposers: Harold O. Davidson, F. W. Sperr, E. W. Hopkins.

**2—Malcolm Howe Carpenter,** Berkeley, Cal.
Present position—1920 to date: Pacific Coast Representative, Mine and Smelter Supply Co.
Proposers: Frank L. Sizer, Clyde Milton Eye, S. K. Dahl.

**3—Edward Dixon,** Yenangyoung, Upper Burma.
Present position—1921 to date: Agent, British Burmah Petroleum Co., Ltd.
Proposers: R. H. French, Paul Weaver, A. Beeby Thompson, Edwin B. Hopkins.

**4—Harry Louis Frevert,** Philadelphia, Pa.
Present position—1921 to date: General Superintendent, Nicetown Works, Midvale Steel & Ordnance Co.
Proposers: W. P. Barba, Stuart Hazelwood, J. C. Agnew

**5—Adolfo Garcia,** Mexico, D. F., Mexico.
Present position—1921 to date: Assistant Chief of the Department of Mines at the Bureau of Industry, Commerce and Works.
Proposers: Victor M. Braschi, M. Perogordo y Lasso, A. F. Main.

**6—Fred Gibbs,** Houghton, Mich.
Present position: Private Practice, Mine Examinations and Reports, Southwest States.
Proposers: Orr R. Hamilton, C. E. Chaffin, Robert M. Peterson, J. B. Cunningham.

**7—F. Morton Leonard,** New York, N. Y.
Present position: Valuation Engineer, J. G. Wray & Co.
Proposers: J. T. Glidden, J. G. Baragwanath, Myron R. Walker.

**8—George S. McCaa,** Pittsburgh, Pa.
Present position—1921 to date: Mine Safety Engineer, U. S. Bureau of Mines.
Proposers: John T. Ryan, George H. Deike, D. J. Parker.

**9—John McLeish,** Ottawa, Canada.
Present position: Director, Department of Mines.
Proposers: Howells Frechette, Alfred W. G. Wilson, Benjamin F. C. Haanel.

**10—Ralph Henry Moore,** Portage, Pa.
Present position: Assistant General Mine Manager in charge of operations.
Proposers: E. S. Moore, Andrew B. Crichton, Telford Lewis.

**11—Joseph Emmet Papin,** Flat River, Mo.
Present position: Superintendent of Mill and Leaching Plant, Kennecott Copper Corp., Kennecott, Alaska.
Proposers: E. T. Stannard, H. M. Lawrence, R. L. Nealy.

**12—Lloyd George Patterson,** Niagara Falls, N. Y.
Present position: Superintendent Lime Kilns, American Cyanamid Co.
Proposers: W. S. Landis, Frank S. Washburn.

**13—Oliver M. Schaus,** Ironwood, Mich.
Present position: Assistant Range Manager, Oglebay, Norton Co.
Proposers: R. C. Allen, V. D. Johnston, W. O. Hotchkiss.

**14—Edgar Frank Karl Seifert,** Lawrence, Mass.
Present position—1920 to date: Operating Chemist, in charge Plant 1, American Anilin Products, Lock Haven, Pa.
Proposers: H. P. Talbot (n.m.)
Endorsed by: American Chemical Society, American Electrochemical Society.

**15—Ernst Alfred Ritter,** Cartagena, Colombia, S. A.
Present position—1920 to date: Geologist, Bataafsche Petroleum Maatschappij, Columbia and Venezuela.
Proposers: W. H. Whittier, Norman L. Jenks, Louis A. Scholl, Jr.

**16—William Josiah Wright,** Shillong, Assam, India.
Present position—1920 to date: Geologist to the Whitehall Petroleum Corporation, charge of parties in Kashmir and Assam.
Proposers: William T. Nightingale, L. G. Weeks, J. K. Knox.

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Associates

**17—Lentilhon Wheeler,** Tampico, Tamps., Mexico.
Present position: Cashier, Chorreras Terminal, International Petroleum Co.
Proposers: J. de N. Macomb, C. W. Gennet Jr., Luther V. Rice.

Junior Associates

**18—George Speed Bugbee,** Tucson, Ariz.
Student, University of Arizona.
Proposers: G. M. Butler, T. G. Chapman, J. Kruttschmitt, Jr.

**19—Thomas J. Finnerty,** Tucson, Ariz.
Student, University of Arizona.
Proposers: G. M. Butler, T. G. Chapman, J. Kruttschmitt, Jr.

**20—Joseph Harry Hughes,** Tucson, Ariz.
Student University of Arizona.
Proposers: G. M. Butler, T. G. Chapman, J. Kruttschmitt, Jr.

**21—Harry Charles Loesche,** Bonne Terre, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, Charles H. Fulton, M. H. Thornberry.

**22—Philip Cecil McConnell,** Long Beach, Cal.
Student, University of California.
Proposers: W. S. Morley, Ernest A. Hersam, Lester C. Uren.

**23—George Day Page,** Tucson, Ariz.
Student, University of Arizona.
Proposers: G. M. Butler, T. G. Chapman, J. Kruttschmitt, Jr.

**24—Henry William Schilling, Hancock, Mich.**
Student, Michigan College of Mines.
Proposers: F. W. Sperr, H. B. Cunningham, Guy E. Ingersoll.

**25—Stephen Cornelius Spindel,** Chester, Mass.
Student, Harvard University.
Proposers: G. H. Clevenger, D. C. Beyer, L. G. Graton, Fred S. Mulock.

Change of Status—Junior Associate to Member

**26—George Mark Komarofskye,** London, England.
Present position: Unemployed (Just escaped from Russia).
Proposers: A. W. Stickney, L. H. Cooke, W. H. Merrett.

**27—Donald Dana Riddle,** New York, N. Y.
Present position—1921 to date: Mining and Petroleum Engineer.
Proposers: Harry J. Wolf.

**28—Charles Francis Williams,** Mansfield, O.
Present position: Mining Geologist, in charge of development.
Proposers: A. X. Illinski, Cony T. Brown, W. J. Deavitt.

# Engineering Societies Library

HARRISON W. CRAVER, Director

The Engineering Societies Library, on the 13th floor of the Engineering Societies Building, 29 West 39th St., New York, contains approximately 150,000 volumes of engineering literature. It is open on week days, excepting holidays, from 9 a.m. to 10 p.m. (5 p.m, July 3 to Sept. 2)

The Library offers, on payment for the extra work required, to supply photoprints or translations of articles, make searches for information, prepare lists of references and suggest books on engineering subjects. The cost of searching is $2 an hour. Translations cost $6 and upwards per thousand words. Typewritten copies, $1 a thousand words. Photoprints, 11 by 14 in., cost $0.25.

When the Library contains two copies of a book, one may be borrowed by a member. Transportation costs must be paid by the borrower.

The Library is at the service of every member. Those who cannot visit it may order searches, translations, copies, etc., by mail.

Address correspondence to the Director of the Library, Harrison W. Craver, 29 West 39th St., New York.

## Book Notices

**Analysis of Non-ferrous Alloys.** By Fred Ibbotson and Leslie Aitchison. Second edition. Lond. and N. Y., Longmans, Green and Co., 1922. 246 pp., diagrs., tables, 6 × 9 in., cloth, $4.

Methods for analysis of non-ferrous alloys recommended by the authors as combining accuracy with speed and convenience in the highest degree; especially suited to the needs of works chemists.

This edition includes additional methods for light aluminum, copper-nickel and chromium-nickel alloys, and the special elements added to copper-zinc and copper-tin alloys, such as iron and manganese.

**Clay Products Cyclopedia.** First annual edition. Chicago, Industrial Publications, Inc., 1922. 252 pp., illus., diagrs., 9 × 12 in., cloth, $3.

The first section consists of definitions of processes, materials and equipment used in the clay industries. Section two describes the associations of clay workers and their activities. Section three is an index to the cyclopedia, classified by plant departments. Section four contains statistical data, specifications, tests and engineering information. Section five consists of catalog descriptions of machinery.

The book presents a large amount of up to date practical information in convenient form for quick reference.

**Coal.** By Elwood S. Moore. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1922. 462 pp., illus., maps, tables, 6 × 9 in., cloth, $5.

Prepared to satisfy the demand for a convenient modern summary of the voluminous scattered literature on coal. Covers quite fully such topics as the properties, origin, uses and general distribution of coal, while discussing only in a more general way such subjects as mining machinery and the details of distribution and character of local deposits.

**Electrical Engineering Testing.** By G. D. Aspinall Parr. Fourth edition. N. Y., E. P. Dutton & Co., 1922. (Directly-useful technical series.) 691 pp., illus., diagrs., 6 × 9 in., cloth, $8.

A systematic course of instruction in testing alternating and continuous current machinery and equipment, for students and for engineers engaged in practical work. The present edition has been considerably enlarged, chiefly by adding new tests, and rearranged so that tests of a like nature are together.

**Elements of Radio Telephony.** By William C. Ballard. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 132 pp., illus., plates, diagrs., 5 × 7 in., fabrikoid. $1.50.

A simple discussion of what happens when messages are sent and received by radio, of the apparatus required to produce these effects, and of its method of operation; also practical unbiased information for the experimenter who wishes to learn what apparatus is necessary to produce certain results. Being intended for non-technical readers, the use of mathematics is avoided almost entirely.

**Fuel and Refractory Materials.** By A. Humboldt Sexton. New edition, revised by W. B. Davidson. N. Y., D. Van Nostrand Co., 1921. 382 pp., illus., diagrs., tables, 6 × 9 in., cloth, $4.

No important alterations have been made in the original text of this well-known work, but minor corrections have been made throughout. The chapters on liquid and gaseous fuels have been modified and enlarged, and the chapter on by-products has been rewritten. The chapters on fuel testing and refractories have been modernized and enlarged.

The book discusses the important industrial fuels, metallurgical furnaces, pyrometry, calorimetry, fuel testing and the refractory materials used for furnaces and crucibles.

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**Inorganic Chemistry.** By T. Martin Lowry. Lond., Macmillan and Co., Ltd., 1922. 943 pp., illus., diagrs., 6 × 9 in., cloth, $9. (Gift of The Macmillan Co., N. Y.)

A large textbook which is intended to bridge the gap between the elementary class book and the larger reference treatises. Presents the subject in a modern way, giving full weight to the influence of physical chemistry. Equilibrium-diagrams have been used freely and important industrial operations described.

**Iron and Its Compounds.** By J. Newton Friend. Lond., Charles Griffin and Co., Ltd., 1921. (Text-book of inorganic chemistry, vol. 9, pt. 2.) 265 pp., 6 × 9 in., cloth, 18s.

This book will be followed by a second volume devoted to the metallurgical chemistry of iron. Like the other volumes of this treatise, the book is intended, without being absolutely exhaustive, to give a concise, suggestive account of its topic, and to furnish numerous references to the leading works and memoirs upon it, and is well arranged for reference use.

**Metallurgy of Iron and Steel.** Based mainly on the work of Sir Robert A. Hadfield. Lond. and N. Y., Sir Isaac Pitman & Sons, Ltd., 1922. (Pitman's technical primer series.) 122 pp., illus., tables, 4 × 7 in., cloth, $0.85.

A brief outline of the discoveries and developments on which are based modern practice in the metallurgy of iron and steel. Stress is laid on the importance of conservation and the assistance rendered in this direction by progress in metallurgy.

**Mining Hand Book, Canada, 1922.** Compiled by R. E. Hore. Toronto, Investor's Mining Hand Book Co. 128 pp., 4 × 6 in., paper, $1; leather, $2.

A brief compendium of statistics relating to mineral production, prices of mining stocks, dividends, etc., and a list of the mining companies of Canada. The situation, capitalization and officers are given. Market data are by J. J. Kingsmill.

**Modern Pumping and Hydraulic Machinery.** By Edward Butler. Second edition, revised. Lond., Charles Griffin and Co., Ltd., 1922. 475 pp., illus., diagrs., 6 × 9 in., cloth, $9. (Gift of J. B. Lippincott & Co.)

For engineers, designers and others engaged in the construction or application of pumping and hydraulic machinery to various purposes. The whole range of pumping appliances, as well as the machinery used in hydraulic transmission and power generation, is treated systematically and exhaustively.

**Notes Economiques d'un Métallurgiste.** By Camille Cavallier. Paris, Gauthier-Villars et Cie, 1921. 153 pp., 6 × 9 in., paper, 3 fr. 50.

These brief economic discussions, by a French iron manufacturer, treat various present problems of French industry, particularly metallurgy. Such questions as the comparison between the foreign trade of France and Germany, the participation of manufacturers in national affairs and the relations of the heads of enterprises with capital and labor are treated, and the causes of and remedies for the present economic crisis are discussed in the light of long experience in industry.

**On the Electro-deposition of Iron.** By W. E. Hughes. Lond., H. M. Stationery Office, 1922. (Dept. of Scientific and Industrial Research Bulletin No. 6.) 50 pp., plates, paper, 6s. 8½d.

Reports the results of an extensive laboratory investigation of the structure of electro-deposited iron, together with the author's conclusions regarding the influence of various factors on this structure. The effects of temperature, current density, and movement of the cathode or electrolyte are given special attention. The conclusion is reached that the general theories entertained in regard to the crystallization of other substances hold also for deposited metal and that the dominant factor governing structure is concentration.

**Petroleum Refining.** By Andrew Campbell. Second edition. Lond., Charles Griffin and Co., Ltd.; Phila., J. B. Lippincott Co., 1922. 297 pp., illus., diagrs., tables, 6 × 9 in., cloth, $8.50.

The only work extant devoted solely to petroleum refining. It is confined to ordinary methods of refining, both in laboratory and works practice, as they have come within the purview of the author, whose experience has been chiefly gained with the Burmah Oil Co., Limited. An extensive bibliography is included.

This edition is identical with the first, except for the correction of errors.

**Les Progrès de la Métallurgie du Cuivre.** Par Auguste Conduché. Paris, Masson et Cie; Gauthier Villars et Cie, 1922. (Encyclopédie Léauté.) 254 pp., illus., 5 × 8 in., paper, 14 fr.

Considerable progress has been made in recent years in the metallurgy of copper, due in part to the technical improvement of machinery and plants, but still more to scientific investigation and to the careful utilization of the chemical reactions that occur. This book is a concise account of this progress. It provides a statement of present knowledge of the properties of copper, the effects of impurities, its alloys, and the methods of smelting and refining, with careful attention to scientific principles and to the economic factors. It also presents a typical example of the value of systematic research and scientific methods for the development of an industry.

**Tables Centésimales pour le Tracé des Courbes.** Par J. Bouchard. Paris, Gauthier-Villars et Cie, 1922. 201 pp., 5 × 10 in., paper, 15 fr.

For civil engineers and surveyors who are using instruments divided on the decimal system. Natural trigonometric fractions on the decimal system to six places of decimals, from zero to a right angle, are given.

**Young Man and Civil Engineering.** By George Fillmore Swain. N. Y., Macmillan Co., 1922. (Vocational series.) 203 pp., 5 × 8 in., cloth, $2.

Doctor Swain writes in interesting fashion concerning the branches of civil engineering, the qualifications necessary for the civil engineer, his education, the characteristics of the profession and the outlook for the civil engineer. His book is well calculated to assist the young man in estimating his own fitness for the profession and to help him direct his education along proper channels.

# Employment Service Bureau

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

Positions of the Bureau are on file in the office of the Engineering Societies Employment Service Bureau and with secretaries of A. I. M. E. local sections.

## Men Available

**Superintendent or Chief Engineer.**—Experienced coal-mining man with good record for production, costs and handling men. Thoroughly familiar with mechanical mining. Interview anywhere. IM–1615.

**Graduate,** 1922, desires position with mining company. Will go anywhere, foreign preferred. Will do anything. Age 21. IM–1616.

**Research Chemist and Metallurgist.**—Graduate Met. E. with varied experience in analytical chemistry and metallurgical research in the practical field and in teaching. Three years mill and underground, six years executive experience. Desires position with a future. Any locality. Married. IM–1617.

**Mining Engineer** seeks position as superintendent or assistant, or on examination work. Western States preferred. Graduate. Six years as assayer, mine surveyor, geologist, ex-1st Lieut. Engineers, and assistant superintendent. Mine examination last 16 months. San Francisco interview. Age 30. Married. IM–1618.

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**Engineer.**—Graduate. Experience in engineering, underground work and in commercial end of mining, especially purchase and sale of ores and metallurgical products. Executive ability. Speaks Spanish. IM–1619.

**Mining Engineer.**—Graduate. Twenty years experience construction, exploration, milling, management and examination. Fluent Spanish. New York interview. IM–1620.

**Geologist.**—Doctor's degree. Graduate of European universities. Linguist. Ten years field experience in Europe and tropics. Open for surveying and teaching. Age 32. Married. IM–1621.

**Mining Engineer.**—Graduate. Twenty-seven years operating mines in western states, Mexico and Central America; also in examination. Speaks Spanish. Employed as superintendent but desires change. IM–1622.

**Metallurgical Engineer.**—Broad experience in heat treatment of iron and steel, also ferrous and non-ferrous alloys. Successful research record. Business experience. Open for any position, technical or commercial, offering opportunities. IM–1623.

**Mining Engineer.**—Graduate. Desires permanent position with mining company. Eight years engineering experience and practice in iron, copper, zinc, coal and petroleum. Also consulting, examination and geological work. Immediately available. Single. Age 37. IM–1624.

**Metallurgical Engineer.**—Graduate. Desires executive, technical, or sales connection. Experience: melter on Heroult electric furnace, making carbon and alloy steel castings; metallurgist and chemist for large steel plant. Metallurgical engineer for carbon and high-speed steel tool manufacturing concern, in charge of chemical, metallurgical testing laboratories and heat treatment departments; metallurgical engineer for automobile drop forging manufacturing concern, in charge of metallurgical laboratory, heat treatment department, crucible steel and brass, bronze, aluminum foundry; works manager and secretary-treasurer of company manufacturing high-speed and other alloy-steel tools by new process. Age 29. IM–1625.

**Superintendent and Engineer.**—Graduate. Eight years experience as engineer, and nine years as superintendent, United States, Canada and Mexico. Married. Desires position as superintendent or chief engineer. IM–1626.

**Private Secretary.**—Two years experience in ore-dressing plant. Prefers position with mining or metallurgical engineer. Twenty-three years of age. Single. Desires to locate in New York City or immediate vicinity. Address replies to W. J. K., care MINING AND METALLURGY, 29 W. 39th St., New York City.

## Positions Open

**Superintendent** for brickyard. Apply by letter. Washington, D. C. V–1626.

**Chemical Engineer** who has had actual experience in putting up naphtalene plants. Apply by letter. New York City. V–1627.

**Engineer** to take charge of erection and operation of plant refining mixture of lead and antimony carrying a quantity of silver. Apply by letter. V–1633.

**Sales Manager.**—Man familiar with sale of raw materials and primary products, preferably acquainted with steel and allied industries. Write fully stating experience and salary desired. Headquarters, Ohio. V–1653.

**College Graduates** (one or two) with two to four years experience for drafting work. Age 26 to 28 years. Some experience in field on heavy construction and part in drafting-room in a central office. Work would consist of designing and detailing concrete and steel structures in connection with hydroelectric developments and estimating and checking same. Ability to make hurried preliminary estimates covering entire hydroelectric plant layout highly desirable. Apply by letter. Massachusetts. V–1655.

**Metallographist** experienced in research work for investigations on electric filaments. Apply by letter. New Jersey. V–1679.

**Graduate Engineer.**—About 30 years of age with experience in production, cost accounting and manufacturing details. Duties confined wholly to field work among a number of factories studying conditions and making recommendations for betterments in methods, equipment and personnel. Apply by letter. Canada. V–1710.

**Young Engineer** with a little knowledge of chemistry, in connection with manufacture of incandescent lamps. New York. V–1718.

**General Manager** for large car-building and repair works. Must have had large and varied experience in manufacture and repair of railroad cars and be familiar with best methods of design and construction, also familiar with management of large numbers of men. Would be in full charge and control of works from a manufacturing standpoint. State experience, age, where at present employed (kept confidential if desired) and time when work could begin. New York City. V–1726.

**Engineer** to handle power-house operation, qualified to know what efficiency should be produced and be able to secure it. Plant consists of approximately 6000 hp. direct oil-fired boilers, and 3500 hp. of waste heat boilers, attached to reverberatory furnaces. Apply by letter. Mexico. V–1754.

**Engineer** between ages of 30 and 45, with at least six years of actual experience in combustion work in burning lower grades of fuel under hand-fired and stoker-feed boilers, also at least five years experience on operation of prime movers, especially turbines and electrical knowledge of conditions existing in a modern power plant. Apply by letter. Illinois. V–1790.

**Metallographist** experienced in research work for investigations on electric filaments. V–1679.

**Sales Engineer and District Manager.**—Manufacturer of conveying machinery wants experienced man, preferably with conveying equipment. Must have good record and be able to get results. Write fully experience, references, age, volume of sales and salary expected. Missouri. V–1727.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| 13th Intl. Geol. Congress | Brussels, Belgium | Aug. 10–19 |
| Lake Superior Min. Inst. | Houghton, Mich. | Aug. 28–30 |
| Iron and Steel Inst. | London, England | Sept. 5–7 |
| Natl. Exposition Chem. Industries | New York, N. Y. | Sept. 11–16 |
| Amer. Electrochem. Soc. | Montreal, Que., Can. | Sept. 21–23 |
| Brazilian Centenary Exhibition | Rio de Janeiro, Brazil | Sept. 7, 1921 to Mch. 15, 1922 |
| Natl. Exposition Power & Mech. Engng. | New York, N. Y. | Dec. 7–13 |
| Amer. Soc. for Steel Treating | Detroit, Mich. | Oct. 2–7 |
| Amer. Mining Congress | Cleveland, Ohio | Oct. 9–14 |

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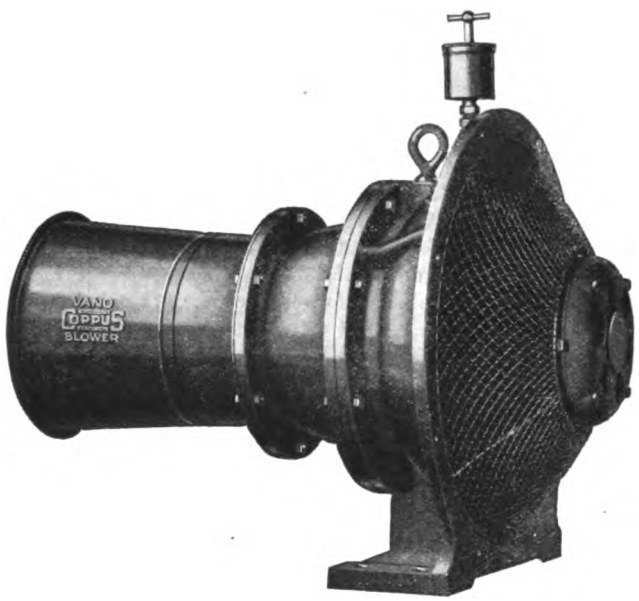
# Industrial News and Developments

**Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.**

## New Type of Propeller Blower

COPPUS Vano blowers, made by the Coppus Engineering & Equipment Co., Worcester, Mass., are screw-blade propeller blowers which deliver the air parallel to the axis, but which differ from other propeller blowers in the following three points: (1) They operate against pressures up to 8 in. water and, therefore, can be employed where, until now, only centrifugal blowers could be used; (2) their efficiency runs up to 80 per cent.;




VANO BLOWER WITH ELECTRIC MOTOR DRIVE.

(3) the power consumption at constant speed is practically unaffected by variations in air delivery or pressure.

The principal feature of the Coppus Vano blower is the stationary guide vane of peculiar design beyond the propeller. The air current leaving the propeller is radially sub-divided by the individual guide vane blades and taken up by them without shock. The guide vane blades which have a curvature, increasing in the direction of the rotation of the propeller, concentrate the air current and give it a further acceleration inside of the stationary guide vane so that a considerable part of the pressure is produced in the latter. A large part of the end thrust is thus taken up by the stationary guide vane casing. The air streams, into which the flow of air has been sub-divided by the guide vane blades, leave the guide vane casing, on account of the kinetic energy, slightly rotating and convergant toward the axis so that the smallest section of the air flow is reached beyond the guide vane casing.

These blowers are built either as single unit machines with one shaft common to blower and driving unit (steam turbine, air turbine, or electric motor), or with shaft extension for overhanging pulley or flexible coupling for connection to steam turbine or electric motor to be mounted on a common base plate.

## Industrial Notes

**B. F. Goodrich Rubber Co.,** Akron, Ohio, announces the appointment of L. A. McQueen as head of its newly created Sales Promotion Department. Mr. McQueen was formerly assistant to the director of advertising.

**Pennsylvania Pump & Compressor Co.,** Easton, Pa., recently opened a direct district office at 105 West Monroe St., Chicago, Ill., with H. M. Montgomery in charge.

**Wilson Welder & Metals Co., Inc.,** 132 King St., New York., recently appointed the King-Knight Co., Underwood Building, San Francisco, Cal., exclusive representatives in central and northern California for Wilson Plastic-Arc Welding Machines and Wilson "Color-tipt" Metals.

**Electric Furnace Construction Co.,** 908 Chestnut St., Philadelphia, Pa., reports an increase in capital and the appointment of the following new officers: P. H. Falter, vice-president and treasurer; Arthur G. Dickson, vice-president and counsel; also appointment of the following new directors: John Gilbert, Wm. A. Webb, T. H. Weisenburg. Frank Hodson retains the presidency of the company.

**The Walker Chemical Co.** and the **Selden Co.,** of Pittsburgh, Pa., have been consolidated into one concern and the business of both companies will be carried on in the name of the Selden Co. No change has been made in either the personnel or management.

## Trade Catalogs

**Adam Hilger, Ltd.,** 75*a* Camden Road, London, N. W. 1, England.—Photogravure of spectrogram, accompanied by a booklet giving a brief account of some recent applications of the spectrograph and a guide for those intending to use it for analysis, especially metallurgical analysis.

**Hercules Powder Co.,** Wilmington, Del.—Booklet, "Eliminating Waste in Blasting," by N. S. Greensfelder. 48 pages, numerous illustrations. Printed and bound in attractive style.

Booklet, "Dynamite—the New Aladdin's Lamp," by T. W. Bacchus. 16 pages. Pen and ink decorations. Rough brown paper, craftsman style, with red initials and rules.

**Thwing Instrument Co.,** 3339 Lancaster Ave., Philadelphia, Pa.—Bulletin 11. Radiation Pyrometers, indicating and multiple-recording types.

**Jeffrey Mfg. Co.,** Columbus, Ohio.—Bulletin 369, illustrating and describing the new Jeffrey belt conveyor. The conveyor is operated by either electric motor or gasoline engine. Capacity varies from 20 to 50 tons per hour, depending on kind of material handled and methods of loading.

**Ludlum Steel Co.,** Watervliet, N. Y.—Folder describing Chippewa Special Vanadium Solid and Hollow Drill Steel.

**International Nickel Co.,** 67 Wall St., New York.—Bulletin 142. Impact Tests on Monel Metal.

Bulletin Index.

Bulletin 1-A. Monel Metal Directory.

**E. H. Stroud & Co.,** 928 Fullerton Ave., Chicago, Ill.—General Bulletin A. Stroud Air Separation Pulverizer.

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# MINING AND METALLURGY

SEPTEMBER 1922


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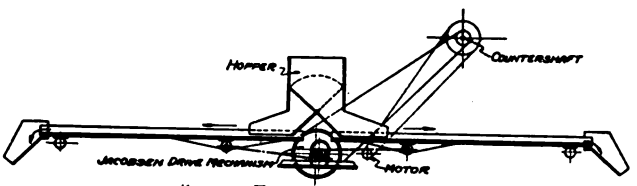

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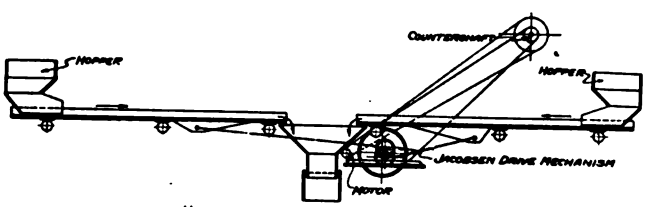

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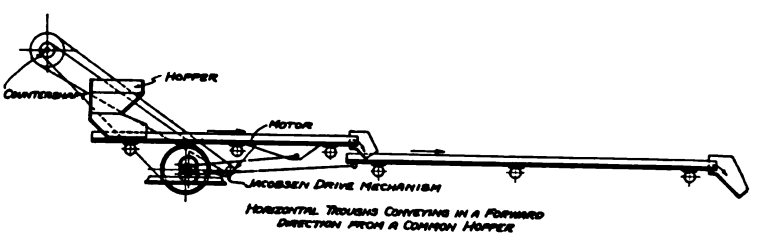

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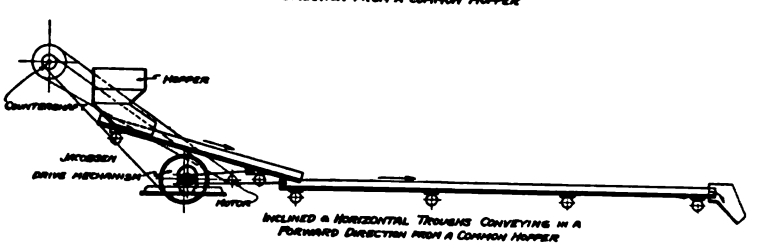

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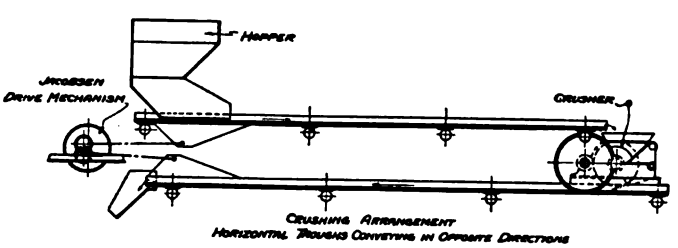

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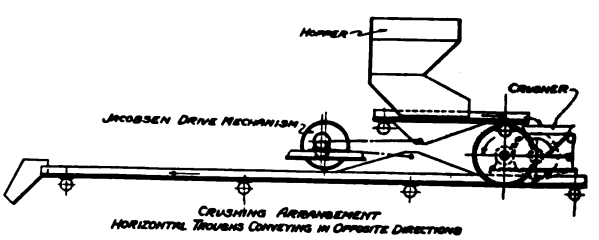

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# MINING AND METALLURGY

THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
29 West 39th Street, New York City, N.Y.

No. 189 SEPTEMBER 1922


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## EDITORIAL

### The Public Loses the Coal Strike

WITH the ratification of an agreement, on Aug. 15, between the United Mine Workers and the operators of the central bituminous field, the union tore a gap in the line of the operators. The Indiana and Illinois operators subsequently entered into agreements, until finally only those of the Pittsburgh district were holding out, and eventually they too yielded. The victory of the miners was then all but complete. They went back to work at the old scale of wages and the operators generally consented to continue the check-off. These were the conditions for which the miners had contended since April 1. The only things that were saved by the operators were the principle of separate agreements and the limitation of the new contracts to April 1, 1923. As I write this article the Pittsburgh operators are still refusing to concede the check-off. Whether they will have the nerve to maintain that position and join the ranks of the non-union operators, I venture no prophecy.

The anthracite operators also offered to surrender, but the labor leaders, arrogant from their bituminous victory, imposed terms that the operators could not swallow, and therefore on this front the war continues.

Even after the Cleveland agreement there was still a chance for the operators to win. That agreement was made with only a small portion of them. Letting this minority, together with the non-union mines, fill the urgent demand for coal, would sooner or later have resulted in breaking up the union and eventually would have put things on a sound basis. That the majority of operators would take such a far-sighted view was probably too much to expect. The temptation of large and quick profits was too great for ordinary human nature to withstand. With the high prices that coal was commanding in a starved market, operators could afford to pay high wages. Under the circumstances they may even claim that they did not lose the strike. Certainly the miners did not lose it. Any



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discussion of this is but quibbling. The definite thing is this:

*With the aid and abettal of their enemies by the politicians, the public lost the strike.*

Gone are the hopes for immediately cheaper fuel, which is needful for the real resuscitation of industry and the promotion of thrift. Doomed are we to grovel under the domination of a labor union, which will tell us what we may have and what we shall pay. In this hour of humiliation, toward which the fostering care of Congress for labor unions has contributed, would it be too much to ask of Congress a little amendment to the effect that membership in the labor unions—our masters—should be restricted to American citizens? This may read like extravagant language, but has not the President of the United States said in a great state paper that the "simple but significant truth" is that "except for such coal as comes from the districts worked by non-organized miners, the country is at the mercy of the United Mine Workers?" Can a virile people, proud of their freedom, come then to any other conclusion than the need and rightfulness of crushing and dissolving the United Mine Workers?

The events of 1922 have been true to form, but the outcome has been different from what was expected. It was always written plainly that 1922 would be a year of great and widespread labor trouble in this country, which would be accompanied by violence and disorder. This was clear for the reason that economic conditions demanded general reduction of wages, which the unions would resist; and it was plainly foreseen that these conditions could crystallize in a coal strike. In the proper order of events there should have been a smashing defeat of the miners, following which the railway men and others would have been able to visualize conditions and the readjustment would have gone fast and to the promotion of the national welfare.

The situation was badly handled, however, out of ignorance of the underlying conditions, which is rather a generous way of putting it. First, the Administration created a false atmosphere by a propaganda for prosperity that would be more or less fictitious. This incited the miners to stand out for their share of it and encouraged a large part of the press to uphold the miners "fighting with their backs to the wall against an attack for the shattering of their union," and even deceived the sentimental public into sympathy for the miners trying to get all they could, the idiotic part of the public that was blind to the fact that the miners meant to rifle their own pockets. Then, when the time came for the exercise of a strong hand in the maintenance of the right of free citizens to work, the Administration exhibited a pitiful pusillanimity. Finally, to cap the climax, the railway strike was precipitated on top of the coal strike. If the labor leaders had had the formulation of this strategy they could hardly have been more skilful from beginning to end. At no time has there been any clear explanation to the public from any quarter whence a voice would command attention, telling that the economic wounds of the war were not healed, that it was a time for patience, hard work and thrift, and that no classes of workers could expect to maintain their war-scale of wages, which could be done only at the expense of other classes of workers.

These conditions are as true now as they were six months ago, or a year ago. Perhaps they are worse, for the labor troubles of this year have caused new industrial wounds. They are not unexpected ones, for the whole series of labor troubles has been simply a part of the process of readjustment, just as there are other parts still to come. The outcome of the coal strike is indeed a retarding one, not in any way a permanent composition. The solemn economic fact is that the American people can not successfully carry on their affairs as a whole with the distribution of the produce of industry in the state of unbalance that the temporary settlement maintains. Not even are monopolistic labor unions able to hold out against economic forces in the long run, but they may prolong the troubles of the rest of the people. The farmers, although they do not know it, are the chief victims, but each group of unionized labor itself suffers from the exactions of all of the other groups. The non-unionized town-workers and the white-collar classes are keen sufferers, like the farmers. That there should be any sufferers is a reflection of the condition of unbalance that I have stated.

The present situation in the coal war is analogous to what was repeatedly seen in military operations during the Great War. The resources of the coal miners were underestimated, as were those of the Germans. That the miners were able to hold out so long in idleness is *ipso facto* evidence of the excessive proceeds that they had been drawing out of the national dividend and is an exposure of the buncombe of the talk about their grievous cost of living. Although we have suffered a repulse on the bituminous front, there is no peace, but only a truce. The war is found to be resumed in 1923 or 1924. Economic conditions will make that unescapable. In the meanwhile the politicians who try to arrange compositions and the operators who consent to sign long-time contracts with the union will be traitors to their fellow citizens and enemies of the public welfare.

W. R. Ingalls.

## The Economic Aspects

ECONOMIC changes do not happen suddenly; appreciation of them may. Last month certain conditions that had been obscure became clear. The defeat of the efforts toward deflation in bituminous coal, and the willingness of the operators to concede the same thing in anthracite, decreed that we are to have high-priced coal for many months to come. The voluntary increase in wages by the U. S. Steel Corpora-

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tion, coming like a bolt out of the blue, spelled higher costs and higher prices for iron and steel. These events, added to other things that had happened and were brewing, produced conviction that the upward trend in prices that had already begun was destined to go considerably further and was likely to be more prolonged than had previously been estimated. The commonplace explanations are "shortage of labor" and "secondary inflation." Those are, however, merely phrases that do not explain, and it is well to examine the underlying conditions more carefully.

Inflation means the extravagant use of credit, either governmental through the excessive printing of notes for currency, or banking through the expansion of loans. Neither of these conditions exists with us, but quite the opposite, the United States being on a gold basis and bank loans having been contracting rather than expanding—"Secondary inflation" is therefore a misnomer.

We are hearing a great deal now about "shortage of labor" and that there is a shortage in certain industries is undeniable, but that the United States is generally deficient in working man power can hardly withstand critical analysis. The restriction of immigration has indeed curtailed new supplies, but not enough to embarass us seriously. It is unfortunate that data on this fundamental subject are lacking, but we may consider the following conditions that are known approximately:

1. Domestic population has increased from 1913 to 1922, but the physical volume of production has not increased in the same ratio; possibly it has not increased at all.

2. Four years ago we were making a rather high rate of physical production, although something like 10 per cent. of our workers had been deducted for military service, while several of our important industries, *e.g.* railway transportation, were overmanned by virtue of political reasons.

3. One year ago there was a high percentage of unemployment among our workers. While there has been amelioration in that condition it has not been complete.

4. We have had important dislocations in our kinds of production, particularly in manufacturing.

There is no illusion, however, about the shortage of labor for some purposes. When the copper mines of the country resumed operations last spring they found that their miners had largely disappeared, and not yet have they come back. The steel producers were obliged to increase wages in order to hold their men. It is obvious that there are not enough building mechanics to do swiftly all the work that we want to have done. What then has become of many of the men who used to be available for work? It is preposterous to imagine that they have emigrated to their old homes in Europe. A few have done so, but I do not think that such a movement plays any great part in the picture. It is incredible that such a result could have been produced in so short a time. I should rather look for the explanation of the so-called "shortage of labor" in the following:

1. The continued use of an increased proportion of workers for the purposes of government. As between 1918 and 1922 there has been no increase under this head, but as compared with 1913 there has been. There is no doubt about this, for we know that the expenses of government increased greatly and show but little tendency to contract.

2. The probability that workers as a whole do not allow themselves to be occupied for so many hours per annum as formerly. In the absence of statistical data on this subject, this suggestion is more or less conjectural, but we know that there has been a great deal of excision of over-time work, extension of the eight-hour day and even of the five-day week. We know also that some of our great industries are overmanned, but that their surplus of men refuse to transfer themselves to other occupations. We are familiar, moreover, with the refusal of many unemployed men to accept any work except what suits them.

3. We know, furthermore, of the diversion of men into new occupations, especially the making, the maintenance and the operation of automobiles, which require garages to house them, improved roads for them to run on, more policemen to regulate their traffic, etc. The great expansion of such a new feature of our life, together with the effort to replace deficiencies in the national housing capacity in haste may easily contribute to the production of a temporary "shortage of labor" without there being any long-time trend in that direction.

We have seen the bituminous coal miners win their strike with no shortage of labor among them, but on the contrary a great superfluity. There is no other explanation than their previous accumulation of such financial reserves that they could live nearly five months in idleness and thus starve the public into yielding to their terms. So it is in different degrees and in different ways with other industries. The underlying factor in it all is the unbalanced redistribution of the national produce which permits some classes of workers to enjoy the luxury of idleness at the expense of others, the strangle-hold of the favored being still too strong to be broken.

However, it is a condition, not a theory, that now confronts us. The wages for labor ought not to go up. but they are going up, and with them are going up commodity prices. Some have already gone up and will hold the gains. Others, like iron and steel, are rising. Others still, that have not yet started, will rise. We may expect an increase in the earnings of some branches of business, a further rise in the stock market and many superficial evidences of prosperity. This will not be unqualified, however, for the new tariff that will be enacted before the end of the year, which will contribute toward higher prices here,

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will at the same time imperil our trade in the goods that we must export. With the economic situation in Europe worse than at any time since the Armistice—with 1,500,000 workers still unemployed in Great Britain, with France fiscally bankrupt, with Germany about to collapse, and with Russia in ruins—the new course of events in the United States is bound to produce repercussions.

We are therefore going to deceive ourselves with the delusions that we can wall ourselves off from Europe, can prosper by merely forcing up prices, and can maintain an unbalanced distribution of the produce of our own industry. The farmers and the white-collar classes will find no ground for happiness in this program, nor will the miners and manufacturers who are constrained to export a large part of their output, among whom of course are the copper producers. The upward movement, which is resembling that of 1919–20 will be short-lived, however, for the reasons that Europe as a big buyer is now absent and more people have clearer perceptions of the economic factors that are moving us. Many of those who will cheerfully swim with the tide will make for shore before the turn to renewed depression begins.

W. R. INGALLS.

## The President on the United Mine Workers

THE President of the United States, on Aug. 18, addressed Congress on the subject of the great national emergency that had been produced by the coal and railway strikes. He made some significant statements, whereof the following especially seem to me to afford ground for introspection and reflection by American citizens who are interested in the general welfare:

It (the coal strike) was instantly made nation wide, so far as the organized mine workers could control, and included many districts in the bituminous field where there was neither grievance nor dispute, and effected a complete tie-up of the production in the anthracite field.

As the strike progressed and entered into its later stages:

Governors in various states reported that their operators and miners had no dispute and were eager to resume production. District leaders informed me that their workmen were anxious to return to their jobs, but that they were not permitted to do so. Hundreds of wives of workmen addressed the White House, beseeching a settlement, alleging that they knew no grievance, and there is an unending story of appeals for relief where necessity of suffering was impelling, where a mere expression of need ought to find ready compliance.

Then the President expressed opinions and made recommendations to which every patriotic American ought to assent:

Another development is so significant that the hardships of the moment may well be endured to rivet popular attention to necessary settlement. It is fundamental to all freedom that all men have unquestioned rights to lawful pursuits, to work, and to live, and choose their own lawful ways to happiness. In these strikes these rights have been denied by assault and violence by armed lawlessness.

In many communities the municipal authorities have winked at these violations until liberty is a mockery and the law a matter of community contempt. It is fair to say that the great masses of organized workmen do not approve, but they seem helpless to hinder. These conditions cannot remain in free America. If freemen cannot toil according to their own lawful choosing, all our Constitutional guarantees born of democracy are surrendered to mobocracy, and the freedom of a hundred millions is surrendered to the small minority which would have no law.

Out of its order in the state paper, but putting it where it ought to be, I transcribe the terrible declaration as follows:

*The simple but significant truth was revealed that, except for such coal as comes from the districts worked by non-organized miners, the country is at the mercy of the United Mine Workers.*

Having made this portentous statement, why should the President have said that "It is of public interest to preserve them," *i.e.* the labor unions, including the United Mine Workers." I like better the words of old Knute Nelson, of Minnesota, who when the Senate was floundering around amid its "remedies" for the strike situation, following the President's address remarked:

We have listened to this discussion with much interest, but it seems to me that all senators have sidestepped the real issue. A skilful physician before he administers a remedy looks to the root of the difficulty. The root of this whole difficulty is unionism. Those bituminous coal mines which have been open shop mines have been running and supplying us with coal and they would have supplied us with more but for the railroad strike. It is not necessary to have the Government operate the anthracite mines. Throw the mines open, allow them to run under what is called the open shop principle and you will have an abundance of coal. Gentlemen, you are afriad to meet the issue, I think.

In the present economic war there are pacifists who are as dangerous as they were during the military war of 1914–18.

W. R. INGALLS.

## Four-months Strike Cost Anthracite Miners Two Years' Savings

THE anthracite mine workers have been subsisting on their savings, of which there should have been large accumulation when the suspension began. According to the Pennsylvania State Department of Internal Affairs, the payrolls of the anthracite companies in 1920 amounted to $237,302,900 and in 1921 the payroll was $283,961,300, the total for the two years being $521,264,200. During these two years the increase, averaging 17.4 per cent., granted by the Anthracite Coal Commission was in effect. If this increase had not been granted, the payrolls would have amounted to $444,100,000, provided, of course, the conditions of employment had been about the same. The increase granted by the commission consequently amounted to $77,164,000, and as following the award of the commission there was a steady decline in the cost of living, it was possible to have accumulated savings considerably in excess of this amount while maintaining the former standard of living.

According to the United States Geological Survey, the average working time in the anthracite region, in 1921, including washeries and dredges, was 271 days; dividing this into the payroll for that year, $283,961,-

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300, we find that the daily payroll in that year amounted to $1,047,827, while on the basis of the wage scale offered by the operators to the miners on May 18, the daily wage scale would have approximated $866,000. Up to the 15th of July, there were 89 possible working days in the anthracite region. If the miners had been employed during that time at the daily rate of $866,000, they would have earned $77,074,000, by which it appears that in their idleness up to that time they had eaten up practically all of the increase that was granted by the Anthracite Coal Commission in 1920.

Reports from the region are to the effect that savings deposits have been reduced, but not exhausted, and it is probable that the provident among the miners can continue in idleness for some time to come without suffering. Many, however, who are not provident are now experiencing privation. The only union funds that are available at the present time so far as we know, are those collected from the maintenance men, against whom double assessment has recently been made. No strike benefits are being paid but the miners' organization has given out a statement that it is taking care of the "needy," whatever that may mean.

Another evidence of the unmitigated waste of this strike to the anthracite miners themselves is the sale of Liberty Bonds, for liquidation of which orders are reported as deluging brokers in the Wilkes-Barre district. All the Government issues are in small denominations, principally $50 and $100 amounts.

There has been some emigration from the region. Some of the aliens have returned to their native countries, and owing to our new immigration laws may have difficulty in re-entering the country. Some may have gone to the non-union bituminous regions and secured employment but the mine workers have been ordered by their leaders not to engage in other employment if the rates paid are less than those they were receiving prior to March 31, namely 52½ cents an hour, and as labor on the roads and other public works is being paid from 30 to 35 cents, it is doubtful if many of the mine workers have taken employment in that line if they are within reach of their rulers. That they have been doing so to a considerable extent is reflected in a press dispatch from Wilkes Barre quoting a member of the Scale Committee as branding such miners as "unfair workmen . . . cutting the wages of other laboring men while clamoring for an increase in their own wages."

PERCY E. BARBOUR.

## Yonkers Gold Mine Fake and Licensing

A PROPERTY covering "at least ten million tons of rock, containing, beyond a doubt, precious metals at a value of $200 to $600 per ton," would be considered an optimistic bonanza even in the Golden West. To some of the people in New York City, however, who are said to comprise some of the greatest suckers in the world, and to the citizens of Yonkers, the adjoining city on the north, all of this seemed plausible. Quarter-page advertisements in the Yonkers daily papers announced the discovery of this rich orebody almost within rifle shot of the Yonkers city hall, and the promoters proceeded to sell stock in the company at $1 per share, announcing naively that "Our office will be open every day in the week until 9 p. m."—and so it was until four of the promoters were arrested and indicted in New York City recently.

The first of these advertisements that came to our notice included the report of an up-state metallurgist, a firm of metallurgists in New York City, and a practical miner, who was said to be a veteran of mining operations in the Ural Mountains, with a Ph. D. after his name and recently a consul at St. Petersburg, all of whom had inspected the property.

The St. Petersburg touch was adroit; and coupled with it, certificates of this mine stock were printed in the Russian language and sold to the Russian populace in New York, where the last census gives 982,000 persons of Russian birth or extraction as residents. A fertile field and close to home.

Despite the fact that there has never been conceived a law that could protect a gullible public against itself, we are told by the advocates of licensing engineers that the mining engineer above all others needs to be licensed to protect the public against fake mining stock. This Yonkers fake worked pretty well, endorsed by men who, although they used scientific titles, did not claim to be engineers. Some unsympathetic mining engineers, members of the Institute, but unlicensed in New York State, had a hand in exposing this swindle.

PERCY E. BARBOUR.

## Flushing of Culm and Mill Tailings into Mine Workings Patented

MINING engineers who for many years have been familiar with the practice of flushing culm and mill tailings into mine workings will be interested in a patent issued during the early part of this year to be a resident of Cleveland, Ohio, for a so-called, "New method of filling up subterranean cavities to eliminate earth collapses in mines."

The merits of this new method as claimed by the patentee are that,

> by means of a water jet, sufficient earth is carried through a pipe system from the surface in that part of the mine which is to be filled up. The mixture of earth and water flows through a pipe system into the cavity where the water will be separated from the earth. The earth forms the filling of the cavity so that afterwards a collapse of the upper layers is impossible while the water may be collected in the mine and pumped back to the surface. This method may be used also in regular mining operation where there exists a danger of mine fires. Besides this, the new filling may be used a few days later as a pillar and all coal walls and all woodwork which now has to remain in the mines may be removed without a collapse of the upper layers.

The cut accompanying the patent papers shows a centrifugal pump flushing earth down a bore hole into

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a cavity, presumably a stope, and another centrifugal pump at the stope lifting the surplus water back to the surface. There is no mistaking the intent of the patent and yet it is inconceivable that even a man who knew only enough about mines to know that there had been caves and subsidence of the surface, as in Scranton, which he mentioned, would not know that the flushing of waste material into mines and stopes had been practiced for years in many parts of the world. More incomprehensible still is the fact that the Patent Office, even allowing for human fallibility, should fall into such an egregious error, particularly with the Bureau of Mines so close at hand to furnish information, which the Patent Office examiners evidently need in a case like this.

PERCY E. BARBOUR.

## Industrial Morale and Employees' Magazines

AT a recent meeting of mining men, a prominent coal operator pointed out the great need of a more general method of reaching the miners with the facts connected with the operation of the employing companies, not only to give the men a broader horizon of the problems pertaining to their employment than they would get from their necessarily restricted work, but also to counteract the flood of printed matter which emanates from various socialistic and labor organizations to the detriment of good management and the welfare and interest of the workers.

There are many methods of accomplishing effectively this result of one of which we shall speak. The leaders of industry have been derelict for years in not meeting, with proper information of their own, the vicious propaganda which they have watched being spread not only by the biased leaders of the big unions but by the thousand of soap-box orators who have without controversion spouted fallacies, untruths and delusions to assembled gatherings everywhere. A properly conducted magazine for the employees has been found to be an excellent method of dealing with such a situation, particularly as it pertains to the individual plant or industry.

That such direct dealing with the men on matters particularly affecting the policy of the company is broad gage and productive of most beneficial results is evidenced by the experience of the Miami Copper Co. when it had to reduce wages, in the experience of the Standard Oil Co. as given by Mr. Hicks in last month's issue, and by the present results of such dealing by the Pennsylvania Railroad with its employees which has kept it almost entirely free from the troubles which have been worrying the other roads.

The American Telephone & Telegraph Co., has long followed this policy and publishes a commendable magazine for its army of employees. The printing and distribution of leaflets from time to time is followed by other industrial concerns two of which, one in New England and one in Pittsburgh, have reprinted for circulation to their employees the leading editorial in the August MINING AND METALLURGY.

It is vitally necessary that the leaders of industry without more delay adopt some method of putting, not only their side of these industrial problems before their workers, but also fundamental economic facts. It is not only good policy, it is their duty. A properly conducted employees' magazine offers a most excellent medium for a beginning.

Through the good offices and coöperation of J. Parke Channing, we were fortunate in securing an article for this issue on "Industrial Morale and Employees' Magazines," by Daniel Bloomfield, one of the authorities in this country on industrial management. The data given should be of great value not only to those mining organizations which already publish such magazines, but to all others who may have contemplated it and also to those to whom the suggestion may be new.

PERCY E. BARBOUR.

## Appointment of Officers of the Reserve Corps

DURING the early months of our participation in the World War, engineers waived the opportunity to obtain commissions and enlisted in engineer regiments recruited for immediateservice in France.

In the event of a future emergency such men would be of inestimable value as officers.

The present project for six volunteer field armies for the National Defense calls for an ultimate strength of 9,000 engineer officers. The present total, including Regular Army, National Guard, and Organized Reserve, is less than 4,000.

For the interest and instruction of Reserve Officers the Engineer School of the Army has devised a series of correspondence courses for all grades from Second Lieutenant to field officers of the higher grade. These courses, have been devised after long consultation with Reserve Officers so that they may give what the military heads deem essential in ways that the Reserve Officer may find to his interest and liking. It is more or less necessary to intrigue him into the study of this profession, to which study he is obligated by the acceptance of his commission. Experience with these courses thus far has been quite satisfactory to the Engineer School and the growing interest has been encouraging. The reserve officers have found them not only of great value from the view point of instruction but find them also vastly and increasingly entertaining.

The Reserve Corps is, now that Congress has emasculated the Regular Army, the chief bulwark to which the country may look for defense in an emergency and since the reserve commission has been made so attractive and such unusual opportunities are being offered for instruction there should be little difficulty in filling up the five thousand vacancies in the Engineer Reserve.

PERCY E. BARBOUR.

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# Review of the Month

AUGUST began with a reminder that warfare was still in progress in the world, in that the Greeks, still at war with Turkey, threatened Constantinople in spite of the small British and French forces of occupation and opened a vista of international dangers. There was in this, moreover, a recollection that religious questions in India had prevented the British from permitting a real settlement of the Turkish question, wherein the absence of Russia as a great power is missed. Civil warfare also continued in Ireland and China. Even in the military way the world is far from being at peace. Bloody fighting between the Fascisti (anti-communists) and the communists in Italy led to several provinces being put under martial law, but after a while these disturbances were quelled. In the latter part of the month the assassination of Michael Collins in Ireland produced a great shock. From China, however, there came rather favorable news, indicating the early reintegration of that country, which sooner or later ought to play an important part in world affairs.

Economically, instead of there being any improvement, there grew a clearer perception of how bad things really are. Italian politics were in chaos through inability to find anyone to accept the premiership and assume the all but hopeless task of averting national bankruptcy. The French, too, began to see their own position in true colors, and especially to see how in reconstruction they had incurred debts on the strength of what they hoped to collect from Germany, with at last the understanding that the Germans could not pay and that France herself was thereby put in a desperate economic position. As for the Germans, themselves their Reichsbank defaulted on ordinary bills early in August. As the month wore on the value of marks fell more and more and at the end it appeared that Germany was on the verge of economic collapse.

On Aug. 7, another international conference (with America again absent) was assembled in London, this being the thirteenth since the war, and there was a general feeling that it would be the last. The prime question was what is to be done about the German reparations, but underlying was the whole subject of the entente. The conference opened like a meeting of importunate creditors, doubtful whether the debtor had any tangible assets. On Aug. 14 this conference broke up without coming to any useful conclusion. Indeed, the acrimony among the premiers was so sharp that even the entente between Great Britain and France was endangered. The international situation was saved only by the Reparations Commission excusing the Germans from the payment of 50,000,000 gold marks that come due on Aug. 15 But although the entente was nominally preserved there is no longer any illusion about the interests of Great Britain and France being different and that henceforth they will play their own hands. The London conference was really an effort to maintain the partnership, and it failed.

In the United States, labor troubles went from bad to worse. The new feature of evil was strikes by the operating forces on numerous lines, on the ground that they would not run trains in bad order (which of course was buncombe) over lines that were guarded by military forces. The strike attained the most serious proportions on the Pacific lines, and for a while practically cut off communication between the Pacific Coast and the eastern part of the country. Great indignation was aroused by the abandonment of many passenger trains in the Arizona desert, whereby their passengers suffered greatly from the intense heat and otherwise. This event, following the Herrin massacre, did more than anything else to arouse popular indignation against the strikers all around. The President of the United States addressed Congress on Aug. 18 on the general subject of our railway and coal mining labor troubles, but his words were received more as an admission of executive helplessness than anything else. On the other hand, there is but little likelihood that Congress will do more than authorize a fact-finding commission to study the coal industry.

In the meanwhile, the United Mine Workers had signed an agreement with some of the operators of the Central Competitive field. This is treated elsewhere in this issue.

On Aug. 20, the Senate passed the Fordney-McCumber tarriff bill, which then moved into conference, where it is likely to remain for many weeks. Nobody knows specifically what will be the outcome, but everybody knows that it will be a higher tariff than the Payne-Aldrich and that it will contain many bad features that are likely to plague us.

August was a month of strength in the spelter market, which held pretty steadily around 6¼ cents, and in the lead market, which rose to 5.90 cents. Resumption of production by the Hercules and Tamarack & Custer mines, whose ore is henceforth to be smelted at East Helena, will augment the supply of lead, but this is needed. The consumption of lead for storage batteries is enormous. Copper was firm, although rather dull, around 14 cents, but at the end of the month was a shade easier. Domestic consumers bought very heavily during the first half of the year, and their takings on previous contracts continued large during August. The prices for all iron and steel products rose sharply during August, especially after the announcement of 20 per cent. increase in wages, which is going to enhance the cost of production.

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## The Bituminous Coal Mining Agreement

THE text of the agreement between the bituminous coal operators of the Central Competitive Field and the United Mine Workers, effected at Cleveland, Ohio, on Aug. 15, is as follows:

1. All mines of operators represented in this joint conference which are now on strike are to be opened immediately upon the execution of supplementary contracts extending to March 31, 1923, the terms, provisions and conditions of the contracts affecting such mines as they respectively existed on March 31, 1922, except as to renewal or continuation clauses in such contracts.

2. The participants in this conference agree to send, and this conference invites the bituminous coal operators of the United States to send representative delegates from coal producing districts, or from substantial groups of operators, which delegates shall as far as possible be representatives of the bituminous coal industry of the United States, such delegates to assemble in joint conference in Cleveland, Ohio, October 2, 1922.

This joint conference shall appoint a committee of equal numbers of representative operators and miners, which committee shall formulate a method to be followed by the bituminous coal industry in the negotiation of wage scale agreements to become effective April 1, 1923, and the method so formulated shall by the committee be reported to the joint conference to be held January 3, 1923, as hereinafter provided.

3. The joint conference convening October 2 shall further select a committee of inquiry, the members of which shall be of commanding public reputation for character and ability, and whose personnel shall be approved by the President of the United States. The duty of this committee shall be to develop promptly all of the pertinent facts in regard to the industry for the benefit alike of the public, the operators and the mine workers. Such investigation shall include every phase of industry deemed material by the committee of inquiry and such committee shall be furnished with all information desired and aided in every manner possible by the operators and miners alike.

In the event such joint conference shall fail to agree upon the members of such committee of inquiry by October 10, 1922, it shall petition the President of the United States to appoint the members thereof in his discretion and in the event of a vacancy the President is requested to fill same by appointment. The cost of such committee of inquiry shall be paid by the industry, one-half by the operators participating in the joint conference and one-half by the United Mine Workers of America.

Such committee, after developing all the facts, shall make such recommendations as it may deem proper and advisable and shall so far as possible embody these recommendations in a report to be submitted to the joint conference to be convened January 3, 1923, as hereinafter provided.

In order to reach a final and proper determination of the controversy in the bituminous coal industry, for the benefit of the miners and operators, and the public as well, the following principal points are presented for consideration by the committee of inquiry:

(*a*) The wage rate in any district shall as far as reasonable be properly competitive within the mining industry and shall at the same time be fully compensatory to the miners, being sufficient to afford not only a living wage but also to allow reasonable opportunity for accumulating savings.

The encouragement of a proper spirit of obligation and responsibility on the part of all the parties toward contractual obligations and the establishment of proper machinery, both local and national, for prompt determination and settlement of any points of dispute in any local, State or district contract without resorting to strike or lockout.

The determination of a proper policy to encourage efficiency of operation not only on the part of mine management in the mechanical operation of the mines but also on the part of individual miners in the performance of their daily work.

4. The participants of this conference agree to send, and this convention invites the bituminous coal operators of the United States to send representative delegates from coal producing districts, or from substantial groups of coal operators, which delegates shall as far as possible be representatives of the bituminous coal industry of the United States, such delegates to meet in joint conference January 3, 1923, at such place as may be designated by the joint conference held October 2, 1922. This joint conference shall receive the report of the committee appointed in conformity with paragraph 2 and shall finally determine the method to be followed by the participants in the conference in the negotiation of wage scale agreements to become effective April 1, 1923.

To the end that new wage scale agreements to be effective April 1, 1923, shall be determined upon as speedily as practicable and further strikes be thereby averted, the method of negotiating wage scale agreements which shall be determined upon by said joint conference shall provide that such machinery as is created by it to develop a new wage scale agreement shall commence to function not later than January 8, 1923. The wage scale agreement concluded by such machinery shall be effective April 1, 1923, and shall be in effect during such time as it may determine.

## New Industrial Films Released

TWO new motion pictures relating to the mineral industry are ready for distribution by the United States Bureau of Mines.

"The Story of Natural Gas" has been produced in cöoperation with the Natural Gas Association of America, and shows in an interesting and informative way the various steps in the development and utilization of natural gas supply, from the drilling of a gas well to the delivery of the gas to the consumer.

"The Story of Oxygen," produced in cöoperation with the Air Reduction Co., shows by the aid of animated cartoons how pure oxygen is produced from air by liquefaction and expansion. This is followed by an exposition of the manifold uses to which oxygen is put in industry.

Copies of these pictures are available for loan without charge to societies and other institutions, for educational purposes. Requests for the loan of the films should be addressed to the United States Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa.

## Exempting Mining Engineers from Licensing in Canada

IN THE bulletin of the Canadian Institute of Mining and Metallurgy for August, 1922, is the following note:

"The Mining Association of the Interior of British Columbia is urging the provincial government to amend the act incorporating professional engineers so that mining, milling and smelting operations will not come within its provisions. This, it is argued, will be following the precedent set by Ontario, which recently exempted the mining business from a similar statute."

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# Economic Causes of Waste Which Increase the Cost of Fuel

By WARREN S. BLAUVELT

President Indiana Coke & Gas Co., Terre Haute, Ind.

IN VIEW of the enormous wastes of natural resources, of labor and of capital, due primarily to the economic environment established by legislation, the general neglect of this phase of the problem of the elimination of waste is difficult to understand. In such a study, the engineering method of attacking a problem should be employed. The engineer does not try to solve his problem by disregarding natural laws, but by utilizing them. The successful engineer establishes an environment in which forces, acting in harmony with natural laws upon an object or objects, will produce the desired results.

The engineer who notices that the water level in a vessel, into which a gallon of water per minute is flowing, is two feet higher than the level in an adjacent vessel, connected therewith by a 6-in. pipe, does not assume that the law of gravity has ceased to work, or that water no longer seeks its level; he examines the connecting pipe for obstacles which prevent the free flow of water.

Some editors, many reformers and most politicians tell us that the law of supply and demand no longer works; hence governmental control of commerce is necessary. Governmental control may temporarily—that is, until trial proves its futility—"insure domestic tranquility" and "promote the general welfare;" but it cannot "secure the blessings of liberty" which it curtails, nor can it "establish justice" which it violates.

## Law of Supply and Demand and Reformers

The economist with an engineering training which he knows how to use will not condemn the law of supply and demand when $10 a ton is paid for coal in Chicago, with a freight rate of less than $1.75 from the Illinois and Indiana coal fields, where coal can be produced profitably for less than $3. He looks for the obstacles which cause so great a difference in level between cost and price; having located these obstacles, he considers how they may be removed most effectively and with the minimum social injury. Evangelical reformers and practical politicians act in a different way; they denounce those who sell their coal for $10, and then proceed by legislation to make the production of coal more hazardous and less profitable.

All of the various phenomena in the coal trade, which actually occurred in 1920, were the results of the natural law that men strive to satisfy their desires by the method which seems to them least repugnant, in the economic environment established by statute laws.

The consumer in Chicago disliked to pay the high price for coal, but by paying it he could keep his factory running; a $10 price for coal was less repugnant than a shut-down; the high price eliminated from the market those consumers whose desire for $10 was greater than their desire for a ton of coal.

The coal operator who would be pleased with capacity operation of his mines at a $3 price, and who had sold 70 per cent. of his capacity production at or below that price, used every means in his power to increase production to satisfy his desire for coal in excess of his contract requirements, which he could sell at an unusual profit. His efforts were largely in vain; his car supply was reduced, and many of his men left him to work for snowbird operators.

## Snowbirds With No Contracts

The snowbirds had no contracts for delivery of coal at low prices. The labor used in digging coal at their mines would have produced more coal in the larger and better equipped mines; hence their name; they cannot compete in a normal market and appear only in a "snowstorm" or a runaway market. In such a market they can pay higher wages than legitimate operators, and still make a higher profit per ton, as their entire output brings the top price. They satisfy their desire for profit in the least repugnant way.

Some mine workers prefer stabilized employment with a legitimate operator, but many drift from mine to mine. This movement, of course, is increased greatly when the snowbirds offer wages materially higher than the district scale. Although the railroads may have ample equipment to insure a full car supply if the demand for coal were uniform throughout the year, irregularity in demand makes car shortages at the mines inevitable during periods of unusual demand or of transportation difficulties. Under the law, carriers are required to supply to all mines their equitable proportion of cars; hence every additional snowbird mine opened decreases the car supply allotted to the legitimate operators, and thus curtails the production of good coal, economically mined and sold on low-price contracts. The inability of the railroads to furnish adequate transportation facilities during 1920 was the direct result of their politico-economic environment.

The inevitable effects of these conditions were: A waste of mine labor, due to employment in the less

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efficient mines, to excessive labor turnover and to idle days when no cars were available.

A waste of capital in well equipped mines, due to shortage of labor and of cars.

An increase in the average cost of coal caused by the diversion of labor and transportation facilities from the mines producing coal at low cost and delivering it on low-price contracts to high-cost mines whose operators had no sale contracts.

Excessive prices caused by competition between consumers in a market where demand exceeded supply gave the reformers and politicians their opportunity to occupy the spotlight. Reformers wish to perform miracles and are guided by their sympathies and not by their intellect; so they endorsed an I. W. W. policy of direct action by legislation to reduce prices, but they did nothing to increase car supply at the mines. They greatly desired low prices; and legislation to secure low prices was less repugnant to them than the study of the economic causes of the coal scarcity at points of consumption.

### The Way of the Legislator

The legislator's desire is to secure such publicity that he may be re-elected or elected to a higher office. To do this it is not necessary to engage in the laborious constructive effort of solving a difficult economic problem, which neither he nor his constituents understand, and the solution of which cannot be demonstrated before the next election; but it is necessary that he should do something dramatic which his constituents will believe is in their interest. So the easiest way in 1920 for the Indiana legislators to satisfy their desire was to pass a law, approved by the reformers, to limit the price of coal, and which, incidentally, might provide jobs for political lame ducks.

Thus natural economic law, working in an environment established by previous legislation, brought on a crisis which resulted in new legislation in Indiana which, had it been sustained by the courts, would have increased the cost of mining coal and the cost of government, but would not have increased the production of coal nor improved the facilities for carrying it to market.

The labor of newspaper agitators, reformers and politicians, which neither increased coal production nor reduced its price, was a further economic waste; and these ill-directed efforts compelled many coal operators to divert their labor from the production of coal to non-productive political and legal activities, involving still further waste.

During the wild market of 1920, wagon mines (that is, mines without railroad sidings) were operated near many industrial towns. Much of the coal thus mined was hauled in trucks to the adjacent towns, loaded on cars and shipped elsewhere; at the same time coal was hauled by rail to the same towns and distributed by trucks. Had the wagon mines delivered only to local consumers, there would have been an additional car supply for the movement of coal to distant points, and the local trucking of coal from cars to consumers would have been eliminated. Waste of trucks, railway facilities and mine equipment was the natural result of an economic environment in which such wastes were more profitable to some individuals than the more economical use of labor and capital in social service.

The freight rate on low-grade screenings from Southern Illinois to some Missouri River points is lower than the rate on better coal from points nearer destination, through which the low-grade coal passes. This "stimulates traffic;" but it encourages waste. An unnecessarily long haul on a low-grade fuel is obviously a national economic waste. Yet freight rates far below averate coal freight rates, and which are lower than the cost of the service, unless other rates are excessive, make such a waste of transportation profitable to shipper and buyer; but the general public ultimately "pays the freight."

Before the war, the byproduct coke industry was generally fairly profitable; and the success of this industry was looked upon as a demonstration of the financial benefits to be gained by those who would serve society by assuming the risks of investing in an industry which conserved the coal and petroleum resources of the country, stabilized the mining and transportation of coal, recovered byproducts from coal which would otherwise have been wasted, and make possible the development of an American chemical industry, of great national value in times of pace and of paramount necessity in war.

### Changes Detrimental to Industry

The economic environment of this industry has been so changed by legislation and administrative action during the past few years that the operation of merchant byproduct coke plants has been made generally unprofitable. These changes detrimental to this industry are:

1. A readjustment of freight rates which has increased the total freight charges paid from mines to destinations on byproduct coke and the coal from which it is made by an amount greatly exceeding the increased freight charges on competing fuels; this change in competitive freight rates had handicapped many byproduct coke plants by an amount greatly exceeding the normal pre-war margin of profit.

2. Local taxes on plants and equipment have been increased, per ton of byproduct coke manufactured, far beyond the increase in taxes per ton of the competing fuels, beehive coke and anthracite.

3. The income tax and the interpretation have increased both the amount and the cost of capital required in the conduct of the industry, per ton of product, by an amount greatly exceeding the corresponding increases per ton of competing fuels, and have greatly increased the risk of improvement in the industry.

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4. In response to the needs of the country during the war, byproduct coke capacity was increased to such an extent that the ammonia now produced in this country is sold at a price much lower than before the war. This is inevitable; but there is a movement under way which, if successful, will still further reduce the price of ammonia by competition from the Government financed plant at Muscle Shoals.

5. Many of the byproduct coke plants supply gas to neighboring cities. In few cases there has been an advance in the price obtained for such gas that approximates the increase in cost of manufacturing it; and the prices obtained are materially lower than the cost of manufacturing gas of the same quality by any other process.

Thus the changes in the economic environment have made the elimination of waste by the operation of byproduct recovery ovens unprofitable to those who have assumed the financial risks of the industry. Chemical and engineering knowledge cannot overcome the handicap of the economic environment established by legislation which disregards natural economic law.

One of the most obvious plans for reducing the danger of fuel shortage in large coal-consuming centers at considerable distances from the coal fields is to establish large coal-storage yards at strategic distribution points, to which coal could be moved when the demand for coal and railroad equipment is light and from which it could be quickly and readily moved to the nearby consumers, when demand exceeds the transportation facilities for moving the required tonnage from the mines.

The general adoption of this plan would make possible a reduction of at least 30 per cent. in the number of men now employed at the bituminous coal mines. It would obviate the necessity of investing additional capital in opening new mines for at least five years. The cost of producing coal would be materially reduced by eliminating much of the waste of capital and labor caused by irregular mine operation. The railways would use existing equipment more uniformly throughout the year, thus reducing their capital requirements and their payrolls. The stabilization of coal mining and transportation would be of inestimable benefit to society generally.

Why is not a plan which would eliminate so much waste adopted? The existing economic environment forbids such an undertaking by denying to the prospective investor the natural reward for performing so useful a public service, by making it artificially hazardous, and by assuring him that if, by exercising extraordinary business ability, under favorable conditions, a profit should accrue, a large portion thereof would be taken by the income tax.

The coal operator would gladly allow the coal-storage plant a large share of the direct savings in mining costs; but none of the savings in transportation costs would accrue to the storage plant; quite the contrary, it would have to absorb the increase in total freight charges due to the short haul movement from the storage yard to the consumer. The community insured against coal shortage would reap a great benefit, which it would not share with its benefactor; on the contrary, it would punish him for assuming the risk of serving his community by levying a tax upon his plant investment and upon the value of the coal stored. If an interruption to coal movement would send up the price locally to a point where profit appeared possible, if we may judge from the past, newspapers, politicians and agents of the Department of Justice would all join in making the public believe that those who had assumed a great risk in order to prevent a coal shortage had caused the shortage and richly deserved imprisonment for life.

The law directly and indirectly affecting the business of producing and distributing fuel make it unprofitable and extremely hazardous for those engaged in the industry to eliminate the most serious wastes for which the public pays. Instead of trying to eliminate those wastes by repealing laws which make waste of labor and capital profitable and the elimination of such wastes unprofitable and extremely hazardous, we pass new laws increasing the police powers of government and adding to the cost thereof, the ultimate effects of which are less production, more taxes, higher costs and greater wastes.

A careful study of the wastes of capital and labor in agriculture, manufacturing, commerce and transportation would show, as in the case of coal, that they are in great part the inevitable result of a politico-economic environment which denies to those who serve efficiently the natural reward of such service. Such wastes can be eliminated only by profoundly altering the politico-economic environment of industry. The continued extension of the police powers of government in the existing economic environment will inevitably result in disaster. A clear apprehension of the truth of this statement is the first step toward the attainment of stabilized prosperity.

## The So-called Coal-strike Settlement

By Eugene McAuliffe*

THE outcome of the so-called bituminous coal-strike settlement will prove:

1. That no settlement was made, merely a surrender, a most complete one, of the public, to President John L. Lewis.

2. That when production is restored it will be under the terms of a truce, the mine workers fully armed, ready to resume the offensive, either in all occupied territory, or in districts or states, as seems most expedient, their opponents the public, completely disarmed, their defenses (the stock pile), wiped out.

3. That grave hardships will be suffered by the public and the transportation lines throughout the winter, in

* President, Union Colliery Co., St. Louis, Mo.

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the form of scant supply, high prices, and a return to the lax preparation methods employed in 1917–18. In addition, the so-called wagon mines will appear by the thousand to further deplete the car supply and to add to the transportation load through the movement of material carrying an ash content running up to 40 per cent. Locomotives will fail by the thousand, setting out trains, congesting traffic, and the transportation lines will again be pilloried as they were during and after the war.

4. That the conditions that are responsible for the position of the industry have been accentuated, by the expansion of old mines and the development of new ones south of the rivers, whose owners will during the next period of light demand use part of the profits made during the summer and fall of 1922, to make further assaults on northern markets. This shift of tonnage creates a permanent charge on the people, representing as it does a longer average transportation haul, which, when expressed in gross freight ton miles, must be paid for by some one.

5. That the mine workers union as now entrenched, the use of force as expressed at Herrin, Ill., and elsewhere unchallenged, are in a position to absolutely impose the rule of a small organized minority on the will of the whole people, while representing but one half of one per cent. of our total population.

6. That the so-called fact-finding commission to be appointed in October, to report three months thereafter, will be unable to make any substantial contribution to the work of creating a wage scale to take effect April 1, 1923; the Western Kentucky miners who worked during this strike doubtless throwing their tonnage into the 1923 maelstrom, their contract expiring March 31 next. The best that can be hoped for is a divided committee and two conflicting reports.

Who and what really is at the bottom of this situation, one that has contributed more to the strangulation of the transportation companies and which after years of comparatively satisfactory relations, at last succeeded in dragging the well composed anthracite industry into the abyss? In seeking an answer to this question it is necessary to set the operator aside. When he talks as he has done for the past eight months about fighting the union, he means to say that he is a voluntary combatant, a Sir Galahad, who enters the lists to joust for his fair lady, the consumer—his lance as long, but not an ell longer than the consumer's storage pile. It is true that his armor is frequently dented but the dents are usually taken out after the noise of conflict ceases, and the fair lady, Miss Consumer, is the one who pays.

When coal operators and the public once have driven into their souls the fact that coal-mine workers can not be out-sat, out-talked, or out-bluffed, we will have made some real progress. This strike that has cost mine labor millions of dollars in wages, that has likewise already cost the consumer millions and will cost him many millions more, was not an idle gesture. Since Runnymede, King John, and the signing of the Magna Charta in 1215, the world has experienced many movements. When house-cleaning time came the same mob psychology asserted itself, the leaders rarely able to express in words the forces that were moving them; nevertheless, time has invariably proved that there was an underlying cause back of every revolt and the Anglo Saxon race has moved forward steadily step by step.

Back of the recurring eruptions that afflict the coal industry are causes so apparent, so easy of cure, that the wonder is that the remedy is not applied. As yet the public has failed, audibly at least, to demand a solution. So let's continue to carry on until it does.

## The Settlement at Cleveland

By P. J. Quealy*

ALL good citizens must admit that a settlement of some character should be made of the bituminous coal strike, but this settlement as made at Cleveland, according to my views, is a complete victory for the strikers, and most unfortunate for the public and the coal operators.

The settlement is misleading as published in the newspapers, for the reason that it was agreed to by a very small percentage of the operators of the four competitive districts, which Mr. Lewis insisted should be fully represented in order to arrive at an interstate basic agreement.

He argued at the joint meeting in Washington, of miners and operators, called by President Harding, against the operators' proposition of district settlements, based on President Harding's proposition to open the mines at once at the 1920 scale (which was the $7.50 basic wage), because all states, including those then working non-union, were not represented—notwithstanding that all the union districts were represented, including the four Central Competitive Districts—that the operators did not fairly represent the industry.

Mr. Lewis flatly declined the President's and operators' proposition, because, first, it provided arbitration, and because all bituminous production was not represented. He now pretends, by agreement with the Central Competitive Field (of which only a small fraction was represented), to have agreed to a basic scale.

Speaking for Wyoming, he seeks to raise the cost of 20,000,000 tons production in Utah and Colorado, whose mines are producing normal tonnage at a basic wage of $5.30, to $7.92 by contract with Wyoming operators, whose possible total production cannot exceed 8,000,000 tons per annum—49 per cent.

Utah and Colorado compete at same freight rates with Wyoming in all markets. The result will be that Wyoming operators cannot operate their mines and furnish their employees any work, unless "he" can

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succeed in forcing his arbitrary will by unionizing Utah and Colorado, by such methods as he used at Herrin, Illinois.

The fact that the Governor of Illinois, or the President of the United States, or the Congress of the United States, now in session, have taken no action whatever leading to the arrest or punishment of a single person in a mob of several thousand strikers, well-known to be guilty of the most atrocious and blood-thirsty crime ever committed in this country, now nearly two months ago, gives recognition to a faction of organized labor who must feel that they are more powerful than the Government itself—which is presumed to protect life and property—by their failure to enforce the laws and the constitution of our country.

The wages and conditions which the Cleveland settlement would inflict upon the public, which consumes the product, is unreasonable, unjust, and tyrannical. This condition is made possible by the weakness and inefficiency of our state and national administrations, which, in order to advance and perpetuate their own selfish political fortunes, are encouraging anarchy and lawlessness, to the detriment of the public and jeopardizing the safe-guarding of our national institutions.

The so-called settlement is merely an agreement between a few selfish weaklings—both operators and miners—who have practically entered into a conspiracy to fleece the public at a time when industrial and domestic requirements of fuel lead to purchasing coal at any price—by reason of Mr. Lewis' power, supported by his factional organization, uncontrolled, unrestricted, and encouraged by those who prefer the political support of labor organizations to the protection of the public of our state and national institutions.

Unless the settlement is coupled with arbitration, with a commission composed of fearless public men of well known character, who can be relied upon to do justice without prejudice, for the period beginning at the expiration of the so-called agreement, it can only result in even a worse strike, April 1, 1923.

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## Collective Bargaining at Cleveland

By Carl Scholz*

THE agreement between the United Mine Workers of America and certain bituminous operators executed at Cleveland on Aug. 14, 1922, is nothing short of a calamity, because it perpetuates the influence of the largest labor organization in the country, and sets aside, as far as it goes, the efforts of the bituminous coal operators to free the country from the tentacles of an organization, which by ruthless warfare has endeavored to obtain control of the coal industry of the United States, and frequently has defied the Government of the country. It is difficult to believe that coal operators who for four months have stood out for what they considered was right and just should now take advantage of a momentary situation to replenish their pocketbooks, when 90 per cent. of the production opposes the terms offered by the miners' organization. It must be realized that once a break is made other operators and sections may have to follow, not because they wish to submit to the dictates of the miners' organization, but because the bankers or consumers absolutely require them to do so.

In view of the attitude of the courts on the check-off and closed shop, this agreement would seem directly in violation of the law. Furthermore, it establishes a monopoly, through the effect of uniformity of wages, upon the selling price of coal. The adoption of the closed shop deprives such men as do not care to come within the jurisdiction of the Mine Workers of their constitutional rights.

When the President's proposal was made to the miners and operators, about the middle of July, when he recommended the return of all men under the old wage scale, including the check-off, his proposal carried with it an arbitration board, and the high scale and working conditions were intended to pacify, for the time being, an organization which seemingly had the country at its mercy. The Cleveland agreement provides for a Commission of Inquiry, without any power or authority. To those familiar with the miners' tactics, the Cleveland agreement is farcical and disgusting, and it is noted with some satisfaction that the operators' associations of Pennsylvania, Illinois, the Southwest and West Virginia have not been beaten to submission and are continuing for equity and justice.

The Cleveland agreement is a fair sample of what the miners term "collective bargaining," and it may be proper at this moment to make reference to the negotiations which took place between the miners' representative and the scale committee of the Kanawha Coal Operators Association, where the writer served on the scale and sub-scale committees. The operators had decided some days previous to pay the President's scale of wages, in order to increase production, and also because the higher price of coal made it possible to do so, and the Association had previously gone on record and advised the miners' leaders that they would not consider any negotiations unless the check-off and closed-shop requirements were omitted. When the invitation was extended to the operators, therefore, no reference was made to the Cleveland agreement, and the operators' committee accepted the invitation and met the miners' representative on Aug. 18. Immediately upon the opening of the meeting, the miners' representative read the Cleveland agreement and stated that it contained their proposal and could not be changed to the extent of a single word. They were unwilling to agree to protect the 5000 men now working in the Kanawha mines, and stated that it was their prerogative to

* Vice-president and General Manager, Raleigh-Wyoming Coal Co., Charleston, W. Va.

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deal with their men according to their own organic law, even though they were given to understand that these men were employed with the distinct understanding that they would work on the open shop, and would not be subject to any fines and penalties, in the event the Kanawha Coal Operators Association should make a contract with the miners. The miners' officials reserved the right to have individual operators sign their contract, but they would not agree to protect the men employed by the coal companies. The inevitable result was a disagreement; the following day about 20 per cent. of the tonnage of Kanawha district signed under the Cleveland agreement, but the remaining 80 per cent. intends to continue its policy—against the closed shop; against the check-off, but with full protection to the 5000 loyal men who saved the country's fuel requirements. Some of the mines no doubt will operate as closed non-union mines, others will work on the open shop basis, but those that signed the Cleveland agreement will work closed union mines.

With the wage question eliminated, this fight, therefore, is clearly carried on by the miners to gain the closed shop and check-off, and it is clear that the issue of wages is not involved. If this cannot be accomplished by fair means, then foul means will be resorted to, as indicated by the massacres at Herrin, Ill., Mordue, W. Va., and Waynesboro, Pa. These three outstanding incidents are too fresh in the minds of the people to be forgotten.

The President, in his message to Congress on Aug. 18, stated in part: "It is fundamental that all men have unquestioned rights to lawful pursuits, to work and to live, and choose their lawful way to happiness. In these strikes these rights have been denied through attack and violence, through armed lawlessness. These conditions cannot remain in free America. If free men cannot toil according to their lawful choosing, all of our constitutional guarantees, born of democracy, are surrendered to autocracy, and the freedom of 100,000,000 is surrendered to the small minority which would have no law."

The question once before asked through these columns is: How long will the American people stand for this oppression?

## The Herrin Conspiracy

AS a result of the apathy on the part of the State of Illinois in regard to the massacre of American mine workers at Herrin, the National Coal Association, over the signature of A. M. Ogle, its president, has sent out a pamphlet entitled, "The Herrin Conspiracy," which gives a full and authentic account of this outrage, and deduces proof of a plot. The circular is accompanied by a letter urging that pressure be brought to bear on Governor Small of Illinois not to permit these murders to go unpunished.

Mr. Ogle says, "This wholesale assassination committed under a flag of truce without doubt was the most outrageous crime ever committed in the history of our country. It strikes at the foundation of industry, at the safety of every home, and at the fundamental principles of our government and of civilization.

"Failure to bring the assassins to justice in Illinois will act as an encouragement to the outlaw element in other communities and tend to spread disregard and even contempt for law and government. Every American citizen must realize the issues at stake. Are we to be cowed into weak and humiliating submission to a lawless minority of the mine workers organization?"

## The Labor Trust

THE end of the 19th century found the so-called "interests" largely in control of the Government, says the *Boston News Bureau*. The "invisible government" before Roosevelt's time was curbed by the Interstate Commerce and Anti-Trust acts. Until Wilson's time the captains of industry who made the United States a world power were recognized as entitled by their ability to be consulted, but through the Interstate Commerce and Anti-Trust statutes they were restricted so that they must not monopolize or restrain trade. They were great builders. Freight and passenger rates were low. Efficiency was at a premium. Strikes were local, not national.

Then came the Wilson régime and its "new freedom." No longer were great builders admired. No more was achievement acknowledged. Never had Morgan, Rockefeller or Hill exerted the power over legislation that Untermeyer, Brandeis and Gompers exercised during Wilson's eight years.

At the end of Wilson's reign, for it was a reign with dictatorial powers granted during the war, a labor oligarchy was established, a monopolistic control of this country. "Collective bargaining" had become "monopolistic bargaining." The great labor unions had immunity not granted any other combinations. The Attorney General had an appropriation to curb trusts, but it must not be used to curb labor trusts.

Now we are in the midst of the contest to decide whether these great labor monopolies shall control the United States. The "Labor Trust" differs from the "Money Trust" markedly. Murder, massacre, insurrection, blowing up of tipples, crippling of engines are recognized as usually accompanying restraint of trade by the "Labor Trust." The "Money Trust," so-called, has been dethroned. The "Labor Trust" must be dethroned. Neither a "Money Trust" nor a "Labor Trust" can be permitted to stop industry and cause starvation. Violence must cease. The right to work must not be destroyed by sabotage or Herrin massacres. If those now in political power cannot or will not maintain law and order, others will be chosen in their stead. It is no time for compromise or surrender.

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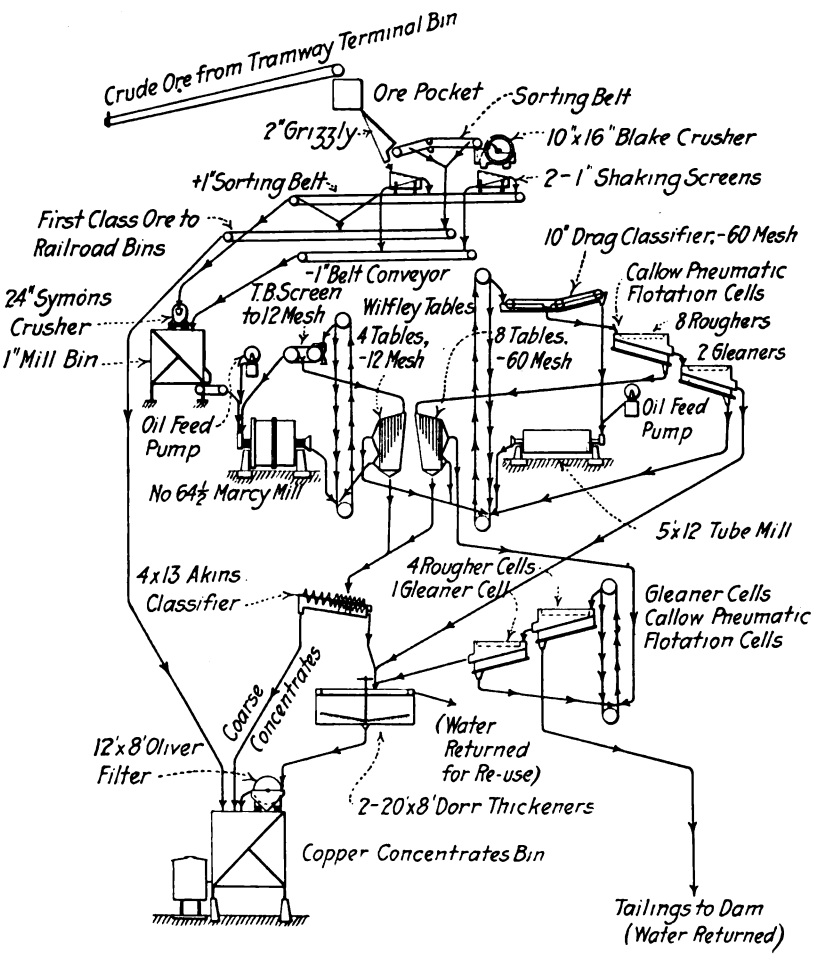
# Treatment of Mixed Sulfide-oxide Ores of Copper*

By H. W. MORSE
Consulting Metallurgist, Stanford University, Cal.

MANY of our largest copper deposits contain both sulfide and oxidized copper minerals. The large porphyry mines, with a total copper content of from 1.3 to 2.0 per cent., send to their mills ore with an oxide content of from 0.2 to 0.4 per cent. While the recoveries of the sulfide minerals are considered satisfactory, using modern flotation practice, the recovery of the oxidized portion of the copper is small; better recoveries of oxidized copper were made before flotation methods were adopted.

Beside the ores containing copper mainly as sulfide, with a small amount of oxidized copper, many of the large porphyry mines have oxide orebodies, in which the proportion of non-sulfide minerals is so high that present methods of treatment are inefficient. In some of the well-known orebodies in the Miami-Inspiration district the copper occurs about equally in sulfide and oxidized forms; and the mixing of minerals is complete throughout the orebody. There is no possibility of mining the sulfides and the oxides selectively. At the New Cornelia mine, however, the oxide and sulfide ores are sharply separated, perhaps by an ancient water level, so that the oxide ore may be mined and treated in a plant built for that purpose, and the underlying sulfide ore may be left for treatment in another plant.

If copper is to be made from an ore having a total content of 1.5 per cent., it must be concentrated or removed from the ore by some hydrometallurgical method. Flotation is generally successful for the sulfide minerals and flotation after filming with sulfide seems to work in many cases on the pure carbonate minerals. Callow has given an extensive report on the results of "sulfidizing" flotation on the ores of the Magma mine.[1] Where such a method can be applied, it may be the best solution of the mixed-ore problem, as it involves no solvent, no precipitant, no expensive plant, and no operation other than the one by which the sulfides are also concentrated. A comparatively small amount of an alkaline sulfide is used to film the carbonate particles with copper sulfide. The sulfide film is so thin that in many cases it is hardly visible and the carbonate concentrate comes off as green as the original minerals in the ore.




FLOW SHEET[2] OF SULFIDE COPPER PLANT. MAGMA COPPER CO.

Unfortunately, much of the oxidized copper in the large porphyry mines is in the form of copper silicate. While it might not be very difficult to coat pure copper

* Excerpt from paper read at meeting of San Francisco Section.

[1] *Trans.* (1917) **56**, 682. [2] *Op. cit.*, 684.

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silicate with sulfide and recover it in concentrated form by flotation, concentration of most of the silicate copper of the Southwest would lead to nothing at all. The copper is in so dilute a solution that a bright blue color may mean a copper content no higher than 1 or 2 per cent. Furthermore, the density of this solution of copper silicate in silica is always less than the density of quartz; which means that gravity concentration, as well as flotation, leads to no result.

### Sulfuric Acid as a Solvent

Dissolving oxidized copper minerals in sulfuric acid is an ancient metallurgical method, but it is only within the past decade that this operation has taken a place in major operations of copper metallurgy. At the plant of the New Cornelia Copper Co., the oxidized minerals are dissolved from the ore with sulfuric acid in large vats, following crushing to about 3-mesh. The solution, containing copper, together with iron, alumina and the other impurities that dissolve from the ore, is passed through towers in contact with sulfur dioxide, to reduce the iron to the ferrous state. The solution is then sent to the electrolytic cells and refined copper is produced directly. After a part of the copper has been removed, the solution is sent back to the ore, with the addition of the necessary amount of "make-up" acid, and the cycle is continued.

Some of the solution, sufficient to cause the discard of the impurities dissolved each day from the ore, is removed from the cycle and passed over scrap iron. A corresponding amount of copper is produced in "cement" form, which is either returned to the main circuit by solution in the ferric iron or is smelted.

If this method is adopted for most of the mixed ores, however, it will require a large plant for the recovery of the oxidized copper following 3-mesh crushing, the first cost of which, about $1000 per ton-day, must be charged to the oxidized copper recovered. While this charge might be reasonable for the New Cornelia plant, with a recovery of more than 25 lb. of copper per ton, it is a high charge for a mixed porphyry ore with a probable oxide copper recovery of 8 or 10 lb. per ton. Following the oxide treatment at 3-mesh fineness, the ore must be ground to flotation fineness and sent through the ordinary flotation operation.

If the ore were crushed to the fineness necessary for flotation, the oxidized copper dissolved in apparatus like that of a modern cyanide plant, the pregnant solution separated from the solids either by counter-current decantation or by filters, and the solids sent to flotation tanks, the saving in plant cost would be very large. While this method involves many questions of acid-proof machinery, none seem difficult to answer in the light of common operations in many chemical plants.

The difficult part of this method often is the nature of the pulp, following treatment with acid. Many ores containing oxide copper are hard to settle or filter at flotation fineness as they come from the mine and they all are much worse after contact with acid. Settling areas of 40 or 50 sq. ft. per ton-day are not uncommon; for a 5000-ton plant, a small-scale operation, this would mean thickeners 400 or 500 ft. in diameter.

The effect of acid on the filtering qualities of some ores is very marked. Recently tests were made with an acid-proof vacuum filter on a mixed ore, ground to a size considered best to give high filter capacity and good washing efficiency. Before the ore was treated with acid, the filter had a capacity of over a ton per square foot per day; after solution of the copper, its capacity was about 300 lb. per sq. ft. per day. The filtration tests previous to acid treatment were with copper sulfate solution, instead of water, so that the washing could be tested on an actual copper solution.

The great change in filtering qualities was caused by the effect of the dilute acid on the solids of the ore, which was very siliceous, with not more than 5 per cent. of total soluble material that could be removed by the dilute acid. Many of the ores now waiting for a mixed-ore process are high in clay and talc and would be even more difficult to handle on filters than this one.

### Treatment of Oxidized Copper by Agitation

Because of the difficulty of separating a pregnant solution from the solids of the pulp, five or six people, at about the same time, decided to grind to flotation fineness and dissolve the oxidized copper by acid in acid-proof Pachuca tanks, or some other form of modern agitator, precipitate the copper as metal, with fine iron, without any separation of solids from the pregnant solution, and float the precipitated copper and the sulfides together. Or, if the conditions of efficient flotation of metallic copper and the particular sulfides of the ore are not the same, float the sulfides out before the addition of the solvent acid, under whatever conditions best suit that operation; and float the precipitated metallic copper after precipitation in the pulp, under the necessary conditions for that flotation operation.

This plan has been tried many times during the past five years, in plants ranging from laboratory scale up to test operations of 100 tons per day. It appears to be feasible, but the nature of the ore must always be considered. Ore that has been out of the mine for some time is always refractory. Tailings, for the same unknown reason, are hard to treat in this way.

Early in the history of this process, it became evident that a special kind of iron would be necessary for precipitation in the pulp; sponge iron proved suitable for the purpose. The direct reduction of finely divided oxide of iron to metal, without melting, is an old process. It has been carried out in crucibles; in horizontal retorts; in modified reverberatory furnaces; in a rotary kiln of Brückner type; in vertical retorts, and pipes. Sponge iron made by these methods is not "sponge" at all. There is no sintering together of the particles of metal, but each bit of oxide is changed

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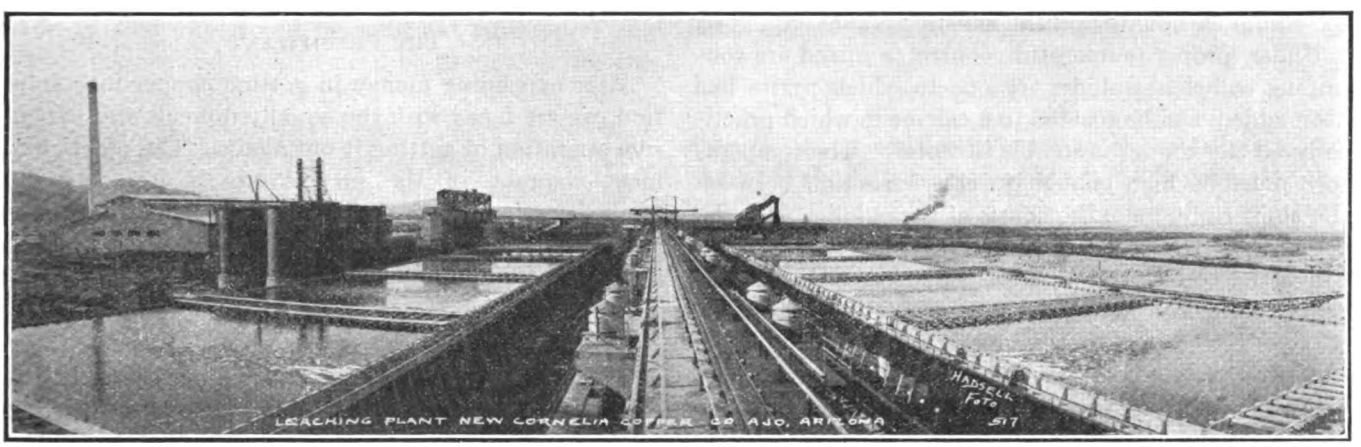
to iron, and at the same time the surface of the particle is enormously increased; very much like the change that takes place in popping corn. Iron in this form seems to precipitate copper in a favorable form for flotation, and the development of the iron-reduction process seems to be the key to the "leaching-precipitation-flotation" operation.

### Sulfur Dioxide and Ammonia as Solvents

Sulfurous acid, which is merely the solution of sulfur dioxide in water, is a good solvent for the oxidized copper minerals and has often been used. The mechanical difficulties do not appear insuperable. The solution of gas in water must be kept confined and applied to the ore in closed towers or, in the case of finely ground ore, in rotating barrels.




Leaching plant, New Cornelia Copper Co., Ajo, Ariz.

The first application of sulfur dioxide as a solvent for oxidized copper was by James W. Neill, at Butte, Mont., in the late nineties. Later, a patent was obtained by Neill and Burfeind, on a cyclic process, including the precipitation of a part of the copper from solution as cupro-cupric sulfite. The process was tried on a small-scale mill at one or two other places, but mechanical difficulties, apparently not connected with the chemical part of the process, prevented full commercial success.

During the past three or four years test plants have been running on sulfur-dioxide leaching, and while the large-scale questions have not been touched, the leaching results have been good in many cases. Sulfurous acid is much slower than sulfuric in the attack on the dilute copper silicate. Assuming complete success as a solvent, we still are confronted with the same difficulty. Shall we build the huge 3-mesh plant; can we separate pregnant solution from pulp; use fine iron precipitate in the pulp and float the precipitated metallic copper, either as a separate operation or with the sulfides?

It has long been known that ammonia, with the addition of an ammonium salt, such as the carbonate, is a good solvent for the oxidized copper minerals and for metallic copper. During the past five years, ammonia has been used successfully in the treatment of ores quite outside the range of any acid solvent. At the Calumet and Hecla mine, ammonia is used to dissolve native copper; at the Kennecott, it is used to dissolve oxidized copper minerals. At both places the ore is so high in calcite that an acid could not be used.

Theoretically, the process is perfect. After solution of the copper minerals, copper is precipitated as oxide by merely heating the solution. Precipitation is therefore a part of the normal step by which the leaching agent is recovered and sent back into the cycle. It appears from what has been published, that ammonia has been used as a solvent only in the treatment of coarse sands, where percolation in covered vats can be applied. Evident mechanical difficulties prevent its easy application to agitation-leaching of finely ground ore.

Where the ore carries a large percentage of acid-soluble impurities, the use of an acid leach is out of the question and the choice of a solvent is limited to ammonia, water (following a sulfating roast), and such solvents as ferrous chloride, which might be used if the percentage of soluble lime, etc. is not too high. The ammonia process is quite sure to find other applications than the two mentioned.

### Iron Salts as Solvents

Many of the processes proposed and patented during the past 20 years depend on the solvent action of salts of iron. The basic principle of all the iron processes is the slight solubility of ferric hydroxide, and the effectiveness of the iron salts is measured largely by the degree of hydrolysis they show. This means merely that an iron salt in solution is a reservoir of dilute acid, and that as fast as this acid is consumed, more is formed, at the same time that ferric hydroxide precipitates.

The most extensive leaching operations in the world are being carried on with the iron salts; these are the great heap-weathering operations at Rio Tinto, Tharsis, and some of the Russian mines. Oxidation of the

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sulfides by ferric sulfate and solution of the oxides by sulfuric acid, also formed from ferric sulfate, are the reactions that take place.

Ferric sulfate (or even better, ferric chloride, where salt is easily available) has many possibilities in connection with a mixed copper ore. It will attack and oxidize the sulfides and will dissolve the oxidized minerals and the artificial oxides resulting from the attack on the sulfides. If an unlimited supply of cheap ferric sulfate were available, the mixed-ore problem would be quickly solved.

### Other Solvents for Oxidized Copper

An incomplete list of processes and patents mentions at least 20 solvents, simple and complex, which are proposed as leaching agents. They range from nitric acid, which is doubtless good but rather expensive, to sodium carbonate and the caustic alkalies.

Under proper temperature control, a mixed ore containing sufficient sulfides, or one to which pyrite has been added, can be roasted to a calcine in which practically all the copper is soluble in water. The temperature must be high enough to cause reaction between the copper minerals, the sulfur of the sulfides, and the oxygen of the air; it must be kept below the point at which the copper sulfate is decomposed. This means that the furnace must be kept within the range 500° to 600° C. At a lower temperature, the reaction is slow and incomplete; at a higher temperature, the copper sulfate is in part decomposed to oxide and acid must be used to dissolve it.

To be efficient, sulfating roasting should give satisfactory commercial recovery of the copper of the ore with water alone, without the necessity of using any acid. A true sulfation of copper is accompanied by reactions that make many of the other constituents of most ores acid soluble. Often as much acid is consumed in dissolving the last 15 or 20 per cent. of the copper as is necessary to dissolve all the copper, following a "dead" or oxidizing roast of the same ore.

### Control of Temperature During Sulfation

The attempt has frequently been made to control temperature during sulfation so that the iron sulfates are decomposed and the copper is water soluble. To accomplish this, the temperature is raised to just above 600° C. toward the end of the roast. In this way, it is possible to make the larger part of the iron of the calcine insoluble in water and slowly soluble in dilute acid; but this seems often to be accomplished at the expense of water-soluble copper.

The most accurate control of temperature during roasting is attainable in a muffle furnace, with which the best results in sulfating roasting have been obtained. During the past four or five years, encouraging results have been obtained by the use of outside combustion chambers, from which hot gases are sent into the furnace proper.

Whether copper sulfate is formed from a copper mineral, the sulfur of a sulfide, and air oxygen, or whether it requires the interposition of a sulfate of iron for its production is not clear. Certainly sulfating roasting with the addition of ferrous sulfate to the charge is easy and rapid; it is quite probable that the sulfates of iron play an important rôle in any efficient sulfating operation.

While so far all sulfating roasting has been on material that was not self-roasting, there is no difficulty about adapting the principle to ores high in sulfur and in getting high water solubilities from such material without the use of any external fuel whatever. Such a method offers an interesting means of getting copper into solution, as the only expense involved in the operation is the charge against roaster operation and the leaching of the calcine with water.

### The Precipitant

After expending money in getting copper into solution, we are faced with the equally difficult and expensive operation of getting it out again. The oldest and most common of the precipitants is iron, usually applied in the form of pig iron or scrap; shot iron is used occasionally, in tumbling barrels. It is not easy to make a neat job of this precipitation.

### Electrolysis

Contrary to the predictions of eminent men in the profession, good electrolytic copper is being made from leach solutions coming directly off the ore. The difficulties in doing this at the plant of the Chile Copper Co., where chlorides and nitrates are dissolved from the ore, seem to have been successfully overcome. The difficulties at New Cornelia are of more immediate interest in this connection, as the oxidized portion of the New Cornelia is much like the oxide ore in other mines where a mixed-ore treatment is being considered.

The successful production of electrolytic copper at Ajo depends on control of the ferric iron in the solution entering the tank house. A good deal of iron, in both ferrous and ferric forms, is dissolved from the ore. More ferric is produced from ferrous during electrolysis, and there is very little reduction of iron during leaching. If satisfactory power efficiency is to be maintained in electrolysis, the iron must be reduced artificially, which is done by saturating the nearly neutral solution, coming from the ore, with sulfur dioxide. Iron is reduced to the ferrous form in this way and a corresponding amount of sulfuric acid results from the reaction.

It may be taken as a general statement that anyone considering the making of electrolytic copper from leach solutions should look carefully at the question of iron dissolved from the ore. In the Miami-Inspiration district the mixed ores are highly siliceous and give up much less iron when treated with acid than do the ores of Ajo. It is probable that the Miami-Inspiration

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ores can be leached and the solutions used for making electrolytic copper with less difficulty than has been experienced in the Ajo operation. It is certain that there are many ores to which the standardized New Cornelia operation can be applied for the recovery of the oxidized copper. As has been already explained, the question of first cost of plant is the hard one to answer. Metallurgically, the problems seem to be solved.

### Sulfur-dioxide Precipitation

If a 2 or 3 per cent. solution of copper as sulfate is saturated with sulfur dioxide in a closed vessel, and heated to a temperature of about 150° C., approximately one half of the copper is precipitated as crystalline metal, with regeneration of a corresponding amount of sulfuric acid. For many ores, the amount of acid made in this way would be sufficient to dissolve the soluble copper and no acid need be brought in for the purpose. The method is not new. The first patent covering it expired in 1921, but so far as I know, it has not been used on a commercial scale.

The full-scale application may not be as easy as the description would indicate. The heating of a dilute copper solution means the expenditure of much fuel and fuel efficiency means, in this case, careful heat interchange between solution going to precipitation and solution returning from it. The vessels in which copper is precipitated must be large if the plant is to turn out 75,000 or 100,000 lb. of copper per day. The sulfur dioxide used in the precipitation must be pure; this means a large plant for making pure sulfur dioxide from roaster or flue gases.

No data on plant or operation costs have been made public, but it seems very likely that the total investment for a plant for sulfur-dioxide precipitation, including the plant for making the pure gas, will not be much less than for making electrolytic copper; the operation cost per pound of copper will be about the same for the two methods. In either case, the cyclic operation cannot be kept closed. A certain volume of solution must be regularly removed and "discarded" to obviate the accumulation of soluble substances from the ore. This "discard" must be "cleaned up" in a plant set aside for that purpose, either by precipitation of the copper on iron, or, if the amount of iron dissolved from the ore is small, by electrolysis. This applies as well to precipitation by sulfur dioxide as to the making of electrolytic copper.

### Hydrogen Sulfide as Precipitant

The use of waste sulfur dioxide is invariably suggested when one considers the smoke escaping from the stacks of a neighboring smelter; equally suggestive is the possibility of utilizing other smelter products as adjuncts to hydrometallurgical processes. Hydrogen sulfide can easily be made from low-grade copper matte, or from matte made specially for the purpose. It might well be used as a precipitant for copper, either from a clear solution or in a pulp, following solution by acid, and preceding flotation, either of the precipitated sulfides alone or together with the natural sulfides of the ore. In either case, precipitation of copper from sulfate solution by hydrogen sulfide results in the regeneration of an equivalent amount of sulfuric acid, and, if the operation takes place in a clear solution, this acid can be used in cyclic operation to dissolve soluble copper minerals from the next batch of ore. As far as I know, this method has been tried only on a test-plant scale of a few tons of ore per day and the results seem to indicate that the expense of the operation, in most cases, will be greater than for precipitation on iron. It seems to be an operation that might advantageously be combined with smelter operation in some cases. It probably has just about the same number of difficulties as any other process of kindred nature.

### Precipitation by Heat Alone

In the ammonia process, during the distillation and recovery of the solvent, copper oxide is dropped out; in the Neill sulfur-dioxide process, raising the temperature of the pregnant solution drives out sulfur dioxide and causes the precipitation of about 75 per cent. of the copper as cupro-cupric sulfite. Precipitation in the ammonia process is complete when all the ammonia is distilled out of the solution. In the Neill process, it is necessary to clean up the solutions with iron or by electrolysis, or with some other precipitant, to get the last of the copper.

### Other Precipitants

The suggested and patented precipitants range from metallic lead to sawdust and from bleaching powder to carbon monoxide gas. Both lime and limestone have been used in extensive tests but neither, so far as I know, in regular commercial operation. Either hydrogen or carbon monoxide will theoretically reduce copper to metal, but practically the action is so slow that it cannot be used. Ferrous oxide would be a good precipitant, but it seems to be harder to make than iron and is not as good.

### Mechanical Handling of Ore and Solution

Practically all the problems connected with the acid-proofing of a leaching plant for sulfuric acid have been solved at Anaconda or at New Cornelia. Far more difficult problems, involving the very corrosive solutions resulting from the action of sulfuric acid on their special ore, have been solved at Chuquicamata, by the Chile Copper Co. The ammonia process offers no difficulties in the line of structural materials. The entire plant can be of iron. The solutions resulting from sulfur-dioxide leaching are of much the same nature as from sulfuric acid.

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There remain the questions covering contact of solution with ore; the separation of solids from pregnant solution; thickeners; filters; efficient precipitating machinery for use with iron, etc.

Based on the successful operation of the Spanish heap-weathering methods, a number of large-scale tests on the heap leaching of mixed ores of copper have been begun in the Southwest. The method is of great interest to many mines, as very low-grade ore, practically waste, stripped from higher grade bodies can perhaps show a profit by this treatment. It is evident that the reactions in these heaps will not be quite the same as in the oxidation of the clean pyrite ores at Rio Tinto, because of the presence of considerable oxidized copper, which will rob the solution of acid during the first stages of the leaching operation. It is quite probable that the oxidized portion of the copper will be largely leached out before the sulfides are attacked.

In these operations the precipitant is always iron, and its use appears to be necessary, as the returned barren solutions from which copper has been precipitated with iron are the active reagents of the process.

Heap weathering and sulfating roasting in a special furnace have been tested on a large scale, at the Shannon Copper Co., on ores with a content of soluble impurities so high as to preclude the application of an acid leach. Leaching was with water and with the iron-salt solutions resulting from precipitation on scrap iron; extractions by both methods were encouraging.

### Advantage of Sulfidizing Flotation

Where the oxidized minerals in a mixed ore consist largely of the carbonates and cuprite, a filming treatment and "sulfidizing flotation" appears to offer the greatest advantage. Both sulfide and oxidized minerals are recovered in the same concentrate and sent to the smelter together. No large plant is necessary and there is only a small expense for extra supplies, compared with regular flotation operation. There will undoubtedly be difficulties with the flotation operation and the final recovery of oxide copper may not be so high as with an efficient solvent, but, with favorable ores, it is hard to see how anything can compare with it.

On many of the porphyry ores, the recovery of oxide copper by this method would be very small; or, if some way were found to float the silicate copper, the grade of concentrate would be lowered to a point where smelting costs would be prohibitive. From most of these ores, the oxide copper must apparently be dissolved by some solvent.

The oxide orebodies, in which the copper is present about half as sulfide and half as oxidized minerals, and where the recovery to be expected is 25 or 30 lb. per ton of ore, might well be treated first by the method used at New Cornelia, to recover the oxide copper, then reground and sent through the regular flotation operation.

The per-ton charge for interest and amortization, to be charged against, say, 15 lb. of copper recovered in the oxide plant, might be 30 cents. While two cents per pound additional cost at this point is a heavy burden, it may be accepted with the certainty of a standard operation. It must be remembered that the interest and amortization charge for any type of oxide plant will be high per pound of copper, on these ores. For the recovery of the oxide copper from the regular milling ore of the porphyries, or from the tails sent out from their mills, some other plan would meet with a heartier welcome. A charge of 30 cents against 6 or 8 lb. of copper is too high. For these reasons, the suggested process of leaching-precipitation-flotation is of special interest. The additional plant necessary is comparatively inexpensive, probably not more than a third as much as for the 3-mesh leaching and electrolytic copper.

The differences in operating cost between sulfuric acid and sulfur dioxide, electrolysis and iron precipitation, or precipitation by sulfur dioxide, cannot be estimated for these ores with any great accuracy. It is not likely, however, that the final estimates would show great differences in any of these combinations. I am inclined to feel that decisions regarding the process to be adopted will turn largely on questions such as certainty and fool-proofness and the availability of standardized methods of handling and treatment.

From the general data at hand, a reasonable forecast of what may be expected to occur might be:

That the oxide orebodies may be treated as at New Cornelia for extraction of the soluble copper; then reground and sent through regular flotation treatment.

That some ores, with a rather high content of soluble copper, may be treated by leaching-precipitation-flotation.

That some low-grade ores will be successfully treated by heap leaching.

That sulfating roasting will be used at favorable points both for the treatment of mixed ores containing a high percentage of soluble impurities and for the treatment of low-grade concentrates high in pyrite.

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## Symposium on Metallurgical Education

IN RESPONSE to requests from many members of the American Society for Steel Treating in the teaching profession that an opportunity be given them to have a conference with metallurgical engineers engaged in commercial industries, so that universities and colleges may prepare their students for greatest usefulness, a symposium on metallurgical education has been placed on the program of the convention of the American Society for Steel Treating at Detroit. It will be held at 4 p.m. on Oct. 3. It is not proposed to discuss the method of teaching metallurgy, but to consider which metallurgical subjects should receive the greatest emphasis.

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# Chemistry of Enrichment of Silver Deposits*

By RUSH T. SILL

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THE processes of superficial alteration depend on physical conditions, environment, geologic history and chemical and mineralogical composition. Superficial alteration is confined particularly to the zone of shallow circulation, as this is the zone of solution; its rocks are open and the circulation within it is comparatively rapid. The enrichment of ore deposits in this zone, therefore, is of special interest.

The depth of the vadose, or zone of shallow circulation, is variable, because its lower limit depends on the variable level of ground water. In moist, hilly countries its depth varies from a few feet to several hundred feet. In arid regions where the rainfall is low and evaporation great, this zone may extend to much greater depths. Permeability of the deposits is essential to the downward migration of metals. In rocks that have been fractured since the primary ore was deposited, there is generally more extensive and deeper enrichment than in ore deposits that have been but slightly fractured. A warm climate increases chemical action and abundant rain fall is favorable to enrichment. Low relief and slow erosion give long periods of weathering and thorough leaching.

## Porosity of Enriched Ores

Ores enriched by precipitation or substitution of certain metals are porous and open textured, particularly in the oxidized zone. They usually show characteristic changes downward; a leached zone near the surface grading into enriched oxides just above the zone of saturation; this grading into a zone of enriched sulfides of higher grade, and this into a zone of primary ore. In moist countries, the zone of secondary or enriched sulfides usually is below the ground-water level. In arid countries, it may be partly or entirely above the ground-water level.

A porous leached outcrop stained with iron will suggest secondary ore below, and a great many deposits are found by following downward nearly barren gossans. Few, if any, silver mines have been discovered of which the outcrops have not shown silver content to some extent.

Rain water carries some carbon dioxide, which renders it a more active agent. When it enters the soil, organic compounds go into solution. The alkali metals, sodium and potassium, are readily dissolved; magnesium and the alkaline earths, barium, calcium and strontium, are attacked, and calcium and magnesium go into solution. The underground waters, then, are chiefly carbonates, chlorides and sulfates of the alkali metals, alkaline earths and other metals. Hot waters in areas of recent volcanism are chloride waters. Under the action of these waters new minerals are formed, especially oxides, hydroxides and carbonates, but most carbonates are unstable under conditions of thorough weathering. The iron carbonate is almost instantly oxidized, forming a visible rusty coating of ferric hydroxide. The lime and magnesia and alkali salts remain partly in solution, to be washed away with much of the dissolved silica.

As silver is transported mostly in the form of the silver sulfate, the source of sulfuric acid is of importance. The iron minerals are the most important sources of sulfuric acid because some of them contain more sulfur than is necessary to balance iron when iron sulfate is formed, and because iron sulfates in the presence of oxygen form ferric sulfate, a powerful and energetic solvent. Ferric sulfate hydrolizes, giving basic ferric sulfate and ultimately limonite.

Native silver is dissolved in dilute sulfuric acid. The solubility of its sulfide, which is only slightly soluble in dilute sulfuric acid, is greatly increased in the presence of ferric sulfate, manganese dioxide or other oxidizing agents. Silver does not form stable carbonates, sulfates or oxides in the oxidizing zone; its chloride is comparatively insoluble. Silver shows little solution or transportation in deposits that carry no appreciable iron sulfides. This statement also applies to the enrichment of other minerals.

## The Silver Halides

Notwithstanding the low solubilities of the silver halides and the nearly universal presence of chlorine in mineral waters, it seldom happens that all the silver dissolved in the upper parts of an argentiferous deposit is fixed as halides (bromide, chloride, iodide). The formation of the chloride near the surface does not entirely inhibit the downward migration of silver. The secondary silver sulfides are numerous and in some veins abundant. The reasons for the fairly extensive downward migration of silver even where chlorides are formed are: (1) Chlorides are present in natural waters in some deposits in amounts insufficient to precipitate as chloride all the silver that goes into solution

* Presented at a meeting of the Southern California Section. Los Angeles, Calif.

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as sulfates; (2) Silver chloride is itself slightly soluble in water; (3) Silver chloride, like other halides of silver, is soluble in an excess of alkali chlorides. Therefore, if a silver solution in the upper part of a deposit contains a small amount of alkali chloride, some silver will be fixed as chloride, but if it contains sufficient alkali chloride, horn silver will be dissolved and will migrate downward with the other metals.

The order of the solubility of the silver halides is chloride, bromide and iodide. All of them are sparingly soluble in water, consequently the halogens precipitate silver from sulfate solutions and the halides may remain in the upper portions of the deposit and give a considerable enrichment at or near the surface.

The carbonate of silver is fairly insoluble but with excess of carbon dioxide under moderate pressure its solubility is greatly increased. This may reach a point where the carbonate is an effective carrier of silver. The great depth to which silver compounds, compared with gold, is carried downward in deposits where calcite and other carbonates abound suggests that the carbonate is an agent of transportation. The precipitation of silver is not retarded by the presence of a large excess of copper sulfate nor by the presence of zinc sulfate. The reaction with chalcocite will go on in the presence of ferric sulfate. In lead-silver ores, the galena is generally richer in silver in the oxidized zone than at greater depths. Kaolin and orthoclase will slowly precipitate silver from solution.

### Precipitating Action of Ferrous Salts

Ferrous sulfate will precipitate silver from solutions of sulfuric acid and ferric sulfate in which silver is present as sulfate. As ferrous sulfate increases and ferric sulfate decreases, the silver held in solution decreases; and with only ferrous sulfate in solution, all of the silver is precipitated. Ferric sulfate will inhibit the precipitation of silver from its sulfate solutions in contact with many sulfides. Hydrogen sulfide and alkaline sulfides precipitate silver from acid solutions.

Silver is carried downward by stages, doubtless, repeatedly going into solution and being precipitated until finally it reaches an environment in which it is more stable either as native silver, as argentite or as one of the complex silver salts. As depth increases the conditions become more and more favorable to its stability; by increase of ferrous and decrease of ferric sulfate, by decrease of acidity by generation of hydrogen sulfide and alkaline sulfides. Any native silver or argentite precipitated near the surface will be redissolved so long as ferric sulfate is present even in minute quantities.

Though there is no invariable rule respecting the relation of the silver chloride, the native metal, the sulfide and the arsenic and antimony sulfosalts in deposits containing all of these minerals, in many deposits these minerals have fairly well defined horizons. The chloride is most abundantly developed above the argentite ore; the antimony and arsenic sulfosalts are found at depths below the zone where argentite is most abundant, but some argentite is found with them. The native metal is found with the chloride and overlapping the zone of the chloride ores; it extends downward with argentite.

In view of the rapidity with which certain minerals decrease acidity and reduce ferric to ferrous iron, one would suppose that deposits containing such minerals in quantities would be enriched to shallower depths than deposits containing the more nearly inert minerals; that deposits containing much pyrrhotite would precipitate silver rapidly and the accumulation of ferrous sulfate in them would prevent the resolution and downward transfer of the silver.

Certain minerals may be grouped in the order of their reactivity, as follows:

*Group* 1.—Pyrrhotite, chalcocite, enargite, the alkali-rich silicates, leucite, nepheline and the iron silicates, olivine, augite and hornblende.

*Group* 2.—Galena and sphalerite and the gangue minerals fluorite, biotite and orthoclase.

*Group* 3.—Pyrite, chalcopyrite, quartz and muscovite.

### Conditions Governing Enrichment

Deposits composed of groups 2 and 3, other conditions being equal, should be more deeply enriched than deposits containing appreciable quantities of pyrrhotite or other minerals of group 1, and the enrichment would not be concentrated in so small a vertical range. Most silver deposits contain some sphalerite and galena and such combinations would cause precipitation at moderate rates and enrichment at intermediate depths. Silver is not precipitated from very dilute silver sulfate by calcite, siderite or rhodochrosite. If a solution of silver sulfate is acid, they will neutralize it, but carbon dioxide is released and the silver remains in solution probably as bicarbonate. Even alkali carbonates do not remove all of the silver from solution. Metallic sulfides in the presence of carbonates will precipitate the silver, the most efficient being pyrrhotite, chalcocite and others acting more rapidly than the inert sulfides, such as pyrite.

### Outcrops

Outcrops of silver deposits may carry silver in concentrated form or may be partly leached of the metal. If the leaching waters carry much chloride, silver will be greatly concentrated at the outcrops, particularly in arid or semi-arid countries. In arid countries smaller amounts of water will percolate through the ore than in wet regions. Many silver deposits are enormously rich at their outcrop but profitless below a depth of 100 ft. Silver chloride forms in moderate amounts in comparatively moist countries.

The concentration of silver as chloride or native metal at the outcrop and in the superficial zone at many places is attended by concentration of the gold, probably because of a decrease in the volume of the ore

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and gangue minerals by weathering. If the deposit contains manganese, gold may be carried downward and be redeposited below. In general, however, gold is more readily precipitated than silver, except the chloride of silver, expecially where the silver-gold ore has a calcite gangue.

### Silver-lead Deposits

A common type of silver ore is composed of argentiferous galena, pyrite, sphalerite and other minerals. The zinc is leached out by weathering, leaving the lead and silver in a concentrated form. If the deposits are in the limestone, the zinc is precipitated extensively as carbonate along fractures and bedding planes, extending outward and downward from the altered silver-lead ore.

### Silver-copper Deposits

Silver and gold may be found in notable concentration at the outcrops of copper deposits that carry little or no copper at the surface, as at Butte, Mont. In general, secondary silver minerals and gold are precipitated nearer the surface than secondary copper minerals. Copper may be held in solution as sulfate in the presence of ferrous sulfate, but the ferrous salt precipitates silver and gold, so that silver and gold will be thrown out of a solution that is depositing chalcocite. Moreover, chalcocite itself precipitates gold and silver almost instantly. It follows that in copper deposits no precious metals of secondary origin will be found below an extensive chalcocite zone. At Butte, the superficial secondary silver ores graded downward into secondary copper ores.

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## Mining and Metallurgy in Foreign Countries

EUROPEAN smelting charges for galena concentrates at present range from 50 to 60 shillings per metric ton, according to the quality of the ore. In European lead-smelting practice, full payment is made for the lead and silver contents of the ore, losses thereof being absorbed in the treatment charge. American silver-lead smelters distribute their costs and losses through a complicated schedule. The American sellers of lead ores would experience a feeling of faintness at the sight of the foreign treatment charges. Their psychology has stood in the way of simplified terms for lead smelting in the United States.

Recently the Spanish Government imposed an export duty amounting to 20 (gold) pesetas per metric ton on copper in matte and 50 pesetas on copper in ingots and cathodes. This led the Rio Tinto Copper Co., which previously had been producing blister copper, to cease operating its converters and begin the exportation of all of its copper in the form of matte, which now goes to Welsh smelters.

At the last annual meeting of the share-holders of the Zinc Corporation Limited, F. A. Govett, the managing director, did not mince matters as regards the effect of trade-union restrictions, the domination of which he rightly characterized as "nothing more nor less than cast-iron tyranny." It is to this tyranny, of course, that the world shortage in the supplies of lead is entirely due. As to the prospects for lead, Mr. Govett remarked that the stocks are low, but consumption is not large. Nevertheless, taking Europe and America together, it is expanding, though with the world in ruins it cannot be great enough to absorb any very large production. The mines being shut down, the remaining stocks are being consumed, and as they disappear, those who can produce cheaply will be able to profit by this fact, but a 35-hr. week and the present rates of pay render cheap output impossible in Australia. To be reasonably safe, he remarked, Broken Hill must be able to produce lead at under £20 a ton, in order to compete.

The Hon. W. L. Baillieu, chairman of the Broken Hill Associated Smelters and of the Electrolytic Zinc Co. of Australasia, in a recent interview with the *Mining Journal* of London, expressed himself rather more optimistically, as follows:

> Broken Hill has been disturbed since the middle of 1919 by serious labor troubles. A special tribunal was created to deal with the dispute, and its award was made under the combined influences of the excessively high metal prices of 1920 and allegations against the conditions under which mining was carried on. A technical committee was appointed by the N.S.W. Government to deal with these allegations; it has just issued its report, which in the main is satisfactory to the companies. In the meantime, the companies have been working under the oppressive award of 1920. It was agreed, however, when this award was made, that it should be revised when the technical committee had made its report. This having been done, I expect a revision to be made just as soon as it is possible to get the machinery of the court into operation.
>
> The costs of smelting in Australia, by reason of the very high metallurgical efficiency of the Port Pirie plant, compare favorably with those of other countries. Coal and transport costs have been maintained at an unduly high level, but these are tending lower; every month sees a decline, and this must continue. The only shareholders in the Broken Hill Associated Smelters are the Broken Hill Proprietary, North Broken Hill, Zinc Corporation, South Broken Hill, and British Broken Hill. There are no private shareholders, and all the companies sell their output under identical contracts to the smelter.
>
> There are roughly 15,000,000 tons of ore blocked out in Broken Hill, and every indication of about a similar quantity to follow before this great field is worked out. It is true that after 40 years of production it is past its prime, taken collectively, but mines like the South, North, British, and Zinc Corporation are capable of developing to even more important concerns than they are to-day.
>
> In 1905 we started zinc concentration at Broken Hill with 13,000,000 tons of zinciferous residues in stacks, plus the current output. By the middle of 1923 the dumps or stacks will be "cut out." This means that after that date we will have to rely on the output of "current ore" only for the zinc-concentrating plants. We have in the pre-war days turned out as much as 500,000 tons of zinc concentrates per annum; in the future we should run about 300,000 tons per annum, subject to lead prices enabling the crude ore to be first profitably treated for lead.
>
> The Electrolytic Zinc Co., which is now producing refined zinc at the rate of 25,000 tons a year, will, when the second half of the power contracted for is supplied (which is expected at the end of the year), produce about 45,000 tons of high-grade spelter a year, and later will increase this total. It will also produce about 6000 tons of lead, 1,200,000 oz. of silver, 10,000 oz. of gold, 200 tons of cadmium, as well as large quantities of leaded zinc oxide, pure zinc oxide, and lithopone, as the subsidiary departments are developed. In addition, with 150,000 tons of chamber sulfuric acid a year at its command, its interests and influence in

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the super-phosphate and chemical industries must become very great.

There are considerable possibilities in New Guinea, which is controlled by Australia. Within a year she will be an important copper producer, and I look for a considerable extension of this industry, the very substantial possibilities of which are now being more widely recognized. The expert reports make it clear that New Guinea will produce copper at costs comparable with the lowest obtainable in any other country.

French engineers are reported to be engaged with the erection at Quang-Yen, in Indo-China, of a plant designed to yield 10,000 tons of spelter per annum out of an oxidized zinc ore.

It has been announced that the Italian Government has decided to raise the subsidy granted to the Sicilian sulfur industry from 100,000,000 to 120,000,000 lire, in order to assist it to meet American competition. The production of Sicilian sulfur is at present less than two-thirds of the pre-war figure.

## Disposal of Blast-furnace Slag

NUMEROUS devices and processes have been devised to dispose of blast-furnace slag. However, most methods are expensive and fail to produce the desired results. The idea presented here has been under consideration for some time, and is protected by recent patents.

For utilization of blast-furnace slag, the following scheme is proposed.

1. Discharge slag directly from furnace into cars, which contain several feet of water.
2. Place disintegrated slag in centrifugal drier.
3. Run product through pulverizer, crushing slag so that 75 per cent. will pass through a 100-mesh sieve.
4. Mix one part of cement with 12 parts of powdered slag, adding small amount of water.
5. Mold the resulting mixture in bricks of standard size, in presses.

Bricks produced from blast-furnace slag have been tested at the Fritz Engineering Laboratory at Lehigh University by E. P. Gangewere, with the following results:

*Transverse Test.*—Supports $\frac{5}{8}$ in. from each end. Width $2\frac{5}{16}$ in., depth 4 in. Span 7 in. Average breaking load, 7000 lb.

*Compression Test.*—Bricks were set on edge, after being broken in half. The following area was subjected to compression: Length $4\frac{3}{16}$ in., breadth $2\frac{5}{16}$ in. Average breaking load, 80,000 lb., or ultimate strength of 8500 lb. per sq. in.

*Absorption Test.*—In a period of 11 days, the bricks absorbed 7.15 per cent. of their weight in moisture.

*Shearing Test.*—When subjected to a double shearing test, they failed at unit load of 1650 lb. per sq. in.

These tests show that bricks produced from blast-furnace slag have a strength far above the average produced from shale or clay. The texture of the bricks is uniform, and an even, smooth surface results from this method of manufacture.

The cost of producing this product is far less than that of making bricks from clay or shale, as the whole process can be operated in conjunction with the blast furnaces of any steel plant.

## Numbering Iron or Aluminum Castings

THE National Automobile Underwriters Conference submitted to the National Automobile Chamber of Commerce an offer of a 20 per cent. reduction in automobile insurance theft rates, if satisfactory methods of numbering engines and frames should be perfected. This offer was submitted by Charles Clifton, president of the National Automobile Chamber of Commerce, to the Society of Automotive Engineers.

The work on developing a satisfactory method of numbering engines and frames was assigned by the Council of the Society to two committees, one made up of engineering representatives of passenger-car manufacturers and the other of the engineering representatives of engine manufacturers. More than twenty suggestions have been received to date and are being tested to determine their relative merits. Further suggestions are desired and should be sent to the Society of Automotive Engineers, 29 West 39th St., New York City.

Some of the methods proposed which are now being tested are: Casting numbers on the crankcase; concentric expanded disks; a special alloy cast in the crankcase; a checker-board system; a small thin fin cast on the crankcase on which numbers could be stamped (the numbered fin would be broken off by the dealer and held for the purchaser); raised number-plates welded to the frame; armor-plate number-plates riveted on, using two or more rivets which enter into the frame construction; fairly large numbers embossed deeply into the frame; small holes punched or drilled into the frames at places where the frames would not be weakened; a thumb-print system; an armored plate riveted into position, with special seals placed over the rivets, case-hardened plugs or plates bearing the numbers, fastened into the frame or engine with blind screws or some other such devices; a series of embossed nickel plates set somewhere in the frame or in the engine in such a way that they could not be removed without tearing down the engine or frame, nickel being advocated as it is not easily affected by the acetylene torch.

**Eliminating Waste in Blasting** is the title of a book recently issued by the Hercules Powder Co., the inspiration for which was received from the engineers report on "Waste in Industry." This is an excellent example of a practical application of the Waste Report for various industries.—*F. A. E. S. Bulletin.*

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# Industrial Morale and Employees' Magazines

By DANIEL BLOOMFIELD

Of Bloomfield & Bloomfield, Consultants in Industrial Relations, Boston, Mass.

ONE of the major problems of management is how to restore in some measure the personal relationship between employer and employed which, in the days of small concerns, meant better morale among employees. The complexity of industry today, the heterogeneous mass of workers employed, many of them new to this country and to its institutions, the inability of those whose task it is to get out production to spend much time on the problems of labor—all these and many other factors serve to make of great importance the question of how to establish more satisfactory mutual good will. While there is no such thing as a sure cure for labor troubles, in spite of the fact that charlatans have been selling alleged cures to guileless employers, study and experience have brought to light methods of approach to the problems confronting management in its relation to labor that are well worth consideration.

Labor problems must be approached with common sense and an open mind. Facts must be the basis of action. So it is with the question of morale in industry. What makes or breaks morale? What are the forces behind the actions of men? What is there in one man that makes him act differently from another man under similar circumstances? How are men affected by the actions of others in their own group or by the actions of those under whose supervision they work? These are questions that must be carefully studied if we are to get at the bottom of industrial unrest.

It is an easy thing to say that good will can be created by "treating men right." That involves so many things and points of view that it will hardly serve as a full answer to our problem; but it is a good starting point if we mean by right treatment the payment of wages consistent with the well being of the worker and his family as members of the community, and if we also mean the provision of sanitary, wholesome working conditions and a working schedule that does not overtax the worker physically, and mutuality—a give and take relationship. With this as a basis we can go a step farther and see what else can be done to promote better relations between management and the workers.

Handling labor is a delicate problem that needs expertness as well as close study of industrial relations in all its phases. This is being realized by those who have seen the weakness of the old system whereby the foreman, for example, was the one who carried the whole burden of man management on his shoulders while he was required to solve many problems of production at the same time. Not that foremen are incapable of managing men; but it was physically impossible for them to give adequate attention both to production and to the many adjustments of men to their work and work to the men, and to the difficulties which arise from time to time between management and the employed forces. Labor problems have become complicated and require much more attention than the average foreman can give. That is why we have seen the organization of special departments in industrial plants under the direction of trained men whose time and attention are given to employment problems. Many of these are men at or near the top of the organization, so important is this matter considered.

## Industrial Morale Must be Fostered

Good organization requires such a man and department where large numbers are employed. In small concerns, also, we find capable men who give a large portion of their time to study of labor problems and development of ways to promote teamwork Industrial morale is not an exotic thing; it has its roots in and must grow from within an organization; and it cannot be developed in a day. Its growth depends just as much on the spirit of the management as on the basic conditions stressed above. If the management is sincere in trying to make employment attractive to those who work for it, that fact will soon make itself felt among the rank and file and then only can steps be taken to maintain good will.

One of the practical ways in which such good will is being developed and maintained in many concerns throughout the country is through the employees' magazine or newspaper. Where such a magazine is established in the proper way, its results fully justify the effort and investment required. Here, as in all other coöperative ventures of management and employees, the enterprise must be well planned and intelligently conducted.

Too often the mistake is made in believing that an

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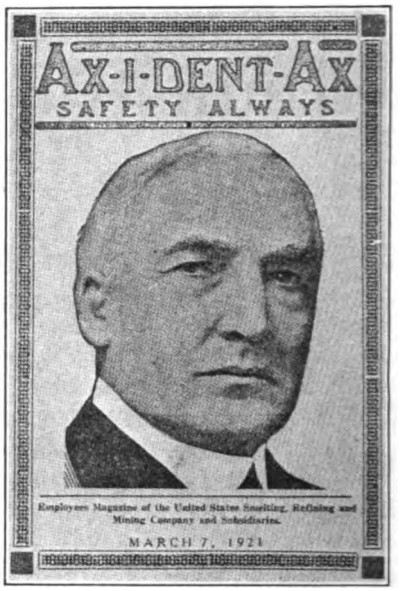
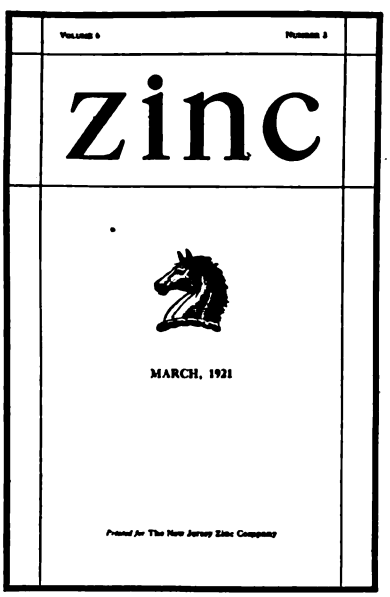
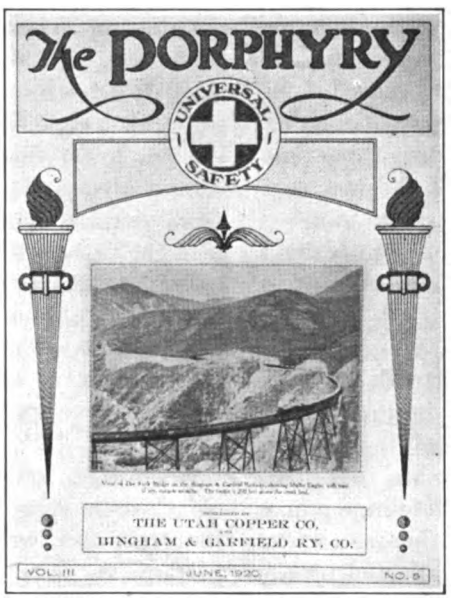
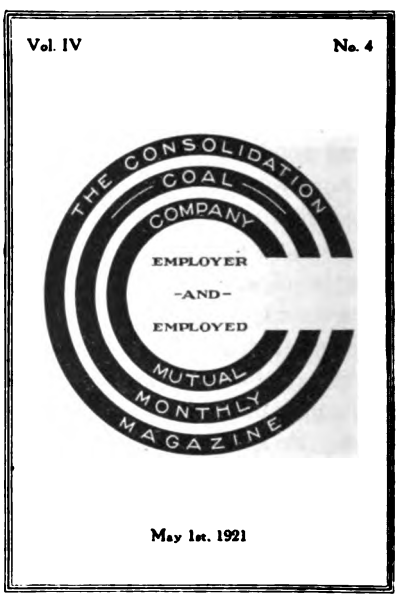
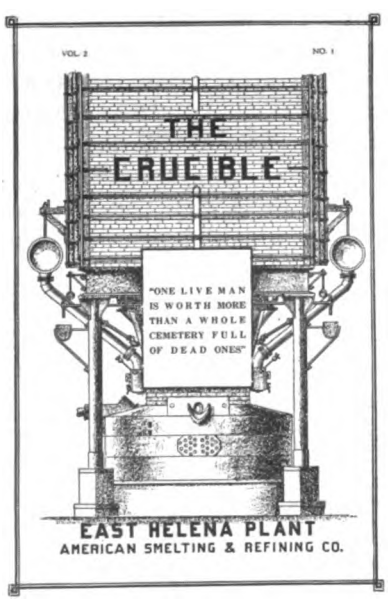
THE ANODE
ANACONDA COPPER MINING CO.
BUTTE MONTANA
Vol. 7 MARCH 15, 1921 No. 3
Listen!
Nobody wants to get hurt at this time o' year!
What, with Summer comin' on and the sun shinin' thru the pines and the trout risin' to the fly. Oh Boy!


AX-I-DENT-AX
SAFETY ALWAYS
Employees Magazine of the United States Smelting, Refining and Mining Company and Subsidiaries.
MARCH 7, 1921





VOL. 2 NO. 1
THE CRUCIBLE
"ONE LIVE MAN IS WORTH MORE THAN A WHOLE CEMETERY FULL OF DEAD ONES"
EAST HELENA PLANT
AMERICAN SMELTING & REFINING CO.

TYPICAL FRONT COVERS OF MAGAZINES PUBLISHED BY WELL KNOWN MINING AND METALLURGICAL COMPANIES.

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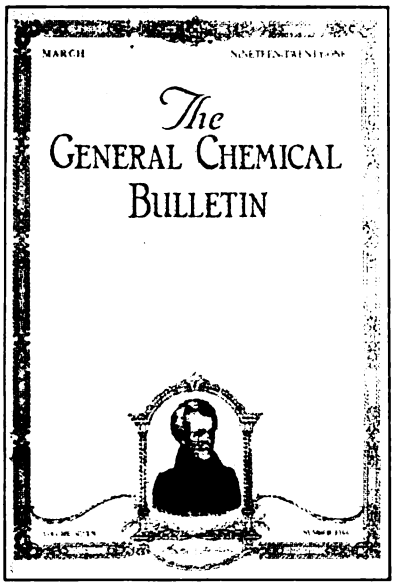

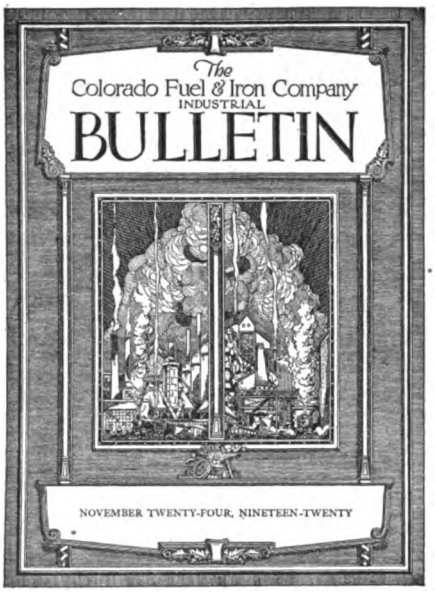


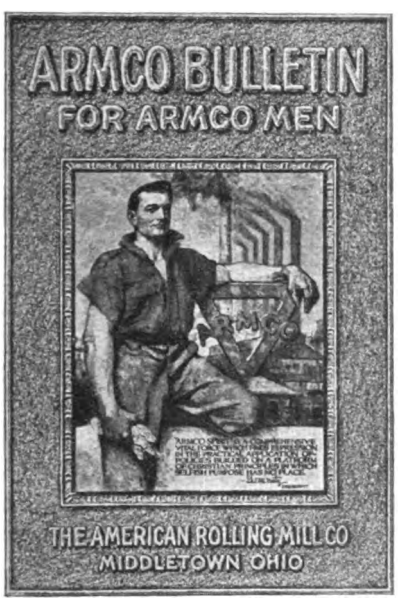


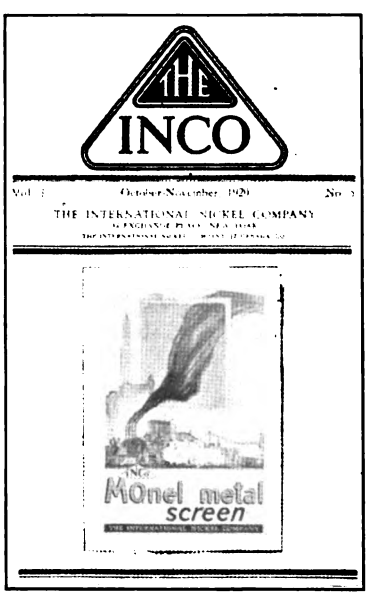


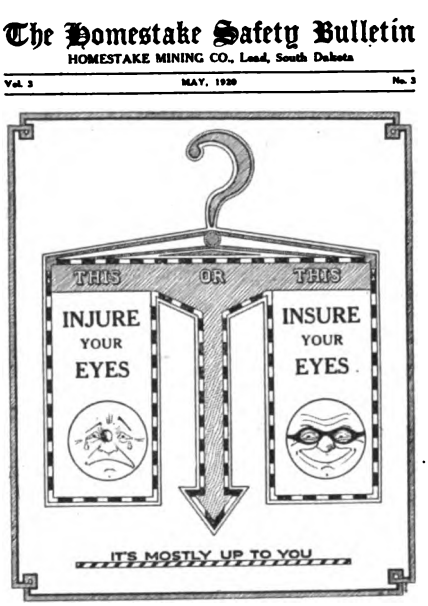

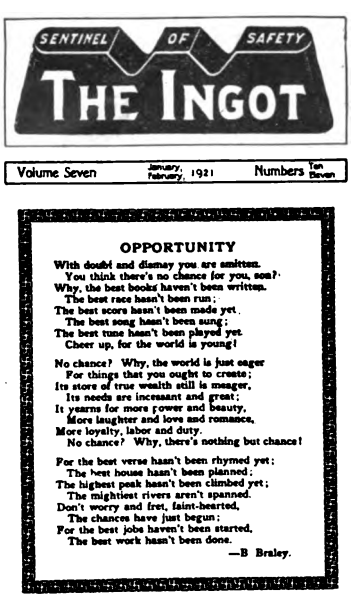
SENTINEL OF SAFETY
THE INGOT
Volume Seven
January, February, 1921
Numbers Ten Eleven
OPPORTUNITY
With doubt and dismay you are smitten.
You think there's no chance for you, son?
Why, the best books haven't been written.
The best race hasn't been run;
The best score hasn't been made yet.
The best song hasn't been sung;
The best tune hasn't been played yet.
Cheer up, for the world is young!
No chance? Why, the world is just eager
For things that you ought to create;
Its store of true wealth still is meager,
Its needs are incessant and great;
It yearns for more power and beauty,
More laughter and love and romance,
More loyalty, labor and duty.
No chance? Why, there's nothing but chance!
For the best verse hasn't been rhymed yet;
The best house hasn't been planned;
The highest peak hasn't been climbed yet;
The mightiest rivers aren't spanned.
Don't worry and fret, faint-hearted,
The chances have just begun;
For the best jobs haven't been started,
The best work hasn't been done.
—B Braley.

TYPICAL FRONT COVERS OF MAGAZINES PUBLISHED BY WELL KNOWN MINING AND METALLURGICAL COMPANIES.

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employees' magazine can be made a success simply by having the publicity department or the sales department make up such a paper and hand it to employees. This is the wrong way to build up a plant spirit.

To determine what the employees' paper is to stand for is the first step. Then effort must be made to live up to that purpose. A study of employee publications throughout the country, made by the Bloomfield organization, throws a good deal of light on this. Here, for example, is what the Burroughs Adding Machine Co. says is the purpose of its employees' paper:

> The primary mission of a house organ might be regarded as that of selling an institution and its products to the employees. Elaborating this, we might say that it performs the function of 'selling' the employee on the conditions of his employment, or bettering those conditions, or furthering any sound industrial propaganda that has an application in the particular industry involved. But after all, these factors can be boiled down into one big objective: The establishment of *esprit de corps*, harmony, and working efficiency. In our own case, this end is accomplished through three channels—information, education, and inspiration.

Another company, The Standard Oil Co. of New Jersey, says that the purpose of *The Lamp*, one of the best papers of its kind, is "to educate without preaching or condescension; to look out for the best interests of the industry rather than for the company alone."

Still another company, The Merchant Shipbuilding Corpn., whose employees' magazine, *The Chester Compass*, the present writer had the privilege of initiating, expresses its purpose in the simple statement that the *Compass* is "a journal devoted to the interests of the employees of the Merchant Shipbuilding Corporation."

The policies of an employees' paper are best developed by joint conference of employees and one or more representatives of the management. Many valuable suggestions are obtainable in this way and employees feel that they are having a definite hand in making the project a success. Where employees are given this responsibility they will take hold with enthusiasm and obtain the coöperation of the rank and file, to make the paper succeed. The management may well lend its assistance in the way of time of a capable representative to help guide the progress of the project, but it is only by stimulating employees themselves to take hold that lasting results may be achieved.

It makes little difference what the nature of the industry is, whether it is a paper mill, an automobile factory, or a copper mine. The principle is the same. Naturally, local conditions will determine the nature of the publication and its administration. If many foreign born workers are employed it may be a good plan to have the material in the publication printed in two languages, English in one column, and the native language of the employees in the other. It may also be best to publish the paper in the form of a small newspaper sheet, as is done by the Goodyear Tire & Rubber Co., or in the form of a more expensive magazine, like the *Telephone Review*.

The cost of the publication may be as large or as small as desired. The total amount spent on employees' publications in the United States each year is over a quarter of a million dollars. A single issue of a paper costs anywhere from $10 to $6000. A semi-monthly paper of six pages published by a western bank costs only $9.50. Others manage to keep the cost of the paper low by the use of the multigraph or the printing plant of the company.

The features that appeal most to employees are plant news and personal notes accompanied by photographs. Here are some of the features found most successful in employees publications:

Photographs of employees, their babies, and families.
Honor Roll for salesmanship or especially meritorious work.
Special articles written and signed by employees.
News of promotions, transfers, resignations, marriages, social affairs, vacations, etc.
Humorous contributions, short and snappy.
Cartoons—people in the plant, local events, etc.
Women's magazine page—household hints, recipes, etc.
"Constructive company information."
Articles by officials of the company telling about their work and problems in a personal way.
Labor-saving devices. Safety articles.
Health articles, short and not preachy.
Articles on European countries and their contributions to American progress.
Stories of "old timers" (men who have long records of service with the company).
Sports—pictures and accounts of games and teams.
Discussion of thrift, benefits and other financial incentives for employees.
Short articles on economics of the industry.
Question box—opinions of readers. Contest for suggestions.
Historical information about company's product.
Stories of how the company's product is used in this country and abroad.
Honor lists for prompt and steady attendance, record production, etc.
Feature articles by foremen on the work of their departments.

What can an employees' paper accomplish? It can serve as a medium for the exchange of constructive suggestions for improving the business; for the expression of company aims and achievement as well as achievements of its employees; for getting employees better acquainted with each other and with the company; for giving employment that personal touch which makes for satisfaction with work; for stimulating employees to do their best by giving public recognition to their efforts; for recording important events of interest to employees and executives. These are but a few of the many things a well organized and conducted employees' paper can do.

How well it can do these things depends on the spirit of the management and on the manner in which it goes about making the employees responsive. "Confidence depends upon deed. The management must show by its acts that it is fair. It must evidence its good faith by getting its workers half-way, and by insisting that its staff do likewise."[1]

[1] Daniel Bloomfield: "Labor Maintenance." New York, Ronald Press Co.

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# A Lay View of the Function of the Federated American Engineering Societies

OF what use is the federation to me and why should I support it?" is a question that has been asked by many members of the constituent societies of the F. A. E. S. during the last year; a question that is asked because the speakers do not realize what the Federated is doing or what is the field of its activities.

"What is it doing for the profession and for mankind?" would be a more appropriate question, the answer to which is found in the closing chapter of Prof. Cassius J. Keyser's "Mathematical Philosophy."[1] The chapter is entitled "Science and Engineering." Professor Keyser writes from the layman's point of view. He is looking at the profession and at engineers from the outside. We have in his thoughts the opportunity that Burns sought when he wrote "Oh wad some power the giftie gie us to see oursels as ithers see us." With the permission of the author and the publisher, we quote the following paragraphs:

A layman, viewing a profession from the outside, seeking thus to ascertain its proper relations to the common weal, may bring to the task a certain freedom, which, were he a member of the profession, he might have lost. "Men trained in a profession," said Prof. David Swing, "come by degrees into the profession's channel, and flow only in one direction, and always between the same banks. The master of a learned profession at last becomes its slave. He who follows faithfully any calling wears at last a soul of that calling's shape. You remember the death scene of the poor old schoolmaster. He had assembled the boys and girls in the winter mornings and had dismissed them winter evenings after sundown, and had done this for fifty long years. One winter morning he did not appear. Death had struck his old and feeble pulse; but, dying, his mind followed its beautiful but narrow river-bed, and his last words were: 'It is growing dark—the school is dismissed—let the girls pass out first.'" I shall not be so much concerned with the present status of the science as with its potence and promise. Of individual engineers the ideals may be high or low, worthy or unworthy; but of engineering itself the ideal is great and mighty. It is of that ideal that I intend to speak.

What is engineering? It is evident that the term stands, or ought to stand, for a great conception. What is that conception? Many attempts have been made to define it. Most of them throw more light upon the character and outlook of those who have made them than upon the nature of engineering itself.

To say that an engineer is one who "knows what to do, when to do it and how to do it" may be true—the formula is very neat—but it can hardly be said to be quite definitive, seeing that it applies equally well to the wisdom of a wise philanthropist and to the cunning of a cunning thief.

To define engineering in terms of aim is no doubt feasible; but to say that the aim is "maximum production with minimum outlay of time, effort and resources" sounds like the "efficiency" cry of brute industrialism, appears to regard quantity as the *summum bonum*, seems to ignore the spiritual autonomy of men and women, and to idealize a "system" in which "laborers" are reduced to the level of machines.

### Great Conceptions of Engineering

To say that the aim of engineering is the "mastering of natural forces and materials for the benefit of mankind" is far better in one respect because it is humane—it represents engineering, I mean, as having for its aim "the benefit of mankind." But what do its sponsors mean by "natural forces?" Do they intend the term to cover the personalities of individual men and women, their perfectly natural civilizing impulses and aspirations? Do they include among "natural forces" the spiritual energies of our human kind—those time-binding powers[2] in virtue of which human beings are human? If they do not, why not? And if they do, what do they mean by "the mastering of natural forces?" The questions are important and some time the philosophers of engineering must answer them.

The most famous conception of engineering and, in

[1] "Mathematical Philosophy, a Study of Fate and Freedom," by Cassius J. Keyser Ph. D., LL. D., New York, 1922, E. P. Dutton & Co.

[2] By time-binding powers is meant the civilizing energies of the world, the knowledge and thought of one generation based on the wisdom of previous generations, the advances of human intelligence based on the achievements of our forefathers. For a fuller explanation, see pp. 428–430 of "Mathematical Philosophy," and Korzybski's "Manhood of Humanity."

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the judgment of many, the best one to be found in the literature, is almost a century old. It is due, I believe to the English engineer, Thomas Tredgold (1788–1829) and is found in the charter of the Institution of Civil Engineers (London, 1828). Engineering is there called an art—"the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, harbors, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the drainage of cities and towns." The gist of the matter is in the first eighteen words: The art of directing the great sources of power in nature for the use and convenience of man. Though found in a charter for civil as distinguished from military engineering, they apply no better to a branch of engineering than to engineering itself, regarded as one great enterprise, and that is why it will repay us to reflect upon them.

In view of their date (1828) it is not strange that they represent engineering as an "art" instead of a science, as we call it today, or a science and art, as, I think, we ought to call it. But that is a trivial matter.

What is not trivial—what is indeed of the gravest importance—are the major emphases in the conception. These are two: one of them is upon the ultimate aim, purpose, or end of engineering; the other is upon means thereto.

What is the former? What is engineering for? Is it for "the use and convenience" of engineers? Or for that of a "shop?" Or that of a manufacturing establishment? Or that of an industry? Or that of a group of "capitalists?" Or that of a class of "laborers?" No; it is for no such restricted good; it is infinitely higher and nobler and more embracing—engineering is for "the use and convenience of man;" and "man" does not mean this group or that; it means all the people of the world, not only those now living but an unending succession of generations to come. The appeal is thus to an imagination great enough to grasp and represent the race. We are wont to say that in things human there can be no perfection. I believe we may say, however, that the ultimate aim, purpose, or end of engineering as presented in that century-old conception of it is a perfect ideal and can never be improved.

But of the other major emphasis in the famous statement the same cannot be said—far from it. For note its incidence. Where does the emphasis fall? It falls upon "directing the sources of power in nature," and the answer is important as indicating the psychology, the attitude and temper, the social philosophy, of an age, an age that still lingers but is being outgrown and is destined to pass. For what is there meant by "nature?" It is evident that what is meant is physical nature, the external universe, the non-human part of the world, and it is evident that the term "power" refers to the blind forces of that "nature"—to wind and wave and tide and gravity and heat and so on. Such things, we say, are non-human—man has great interest in them but they have no interest in man—and when they are made, as they can be made, to serve human welfare, what is it that makes them serve? Everyone knows the answer; what makes them serve is human thought—it is human intelligence and purpose and will—it is the power that invents—the power that observes and remembers and imagines and conceives and reasons and creates—it is, in a word, what we may for convenience call the *spiritual energies* of our human kind. These energies are just as natural as Tredgold's "power." The reflection is no doubt just but it is very obvious. Why, then, insist upon it so? Because, as you must see, it fundamentally alters the traditional point of view. We are seeking a just and worthy conception of the science and art of engineering, and the reflection in question radically shifts the incidence of the major emphasis. It shifts it from the non-human to the human, for it is clear that what requires "directing"—what requires to be *engineered*—is *primarily*, not the blind forces of external nature, but those other natural forces—the spiritual energies of man. It is perfectly evident that the ultimate aim and ideal of engineering—the welfare of our human kind—not only demands the conquest of physical nature, not only demands subjugation of the non-human forces of the world, but also demands, as even more essential, world-wide enlightenment of human beings, world-wide coördination of human effort, world-wide establishment of justice; and it is perfectly evident that the sole means to these great ends is the understanding and "directing"—the "engineering," if you please—of what we have called the spiritual energies of man. They are the energies that make man the creator of civilization: man is their sole agency, their sole instrument, their sole organ; characteristic of human kind, they are present in some measure wherever human beings are found. Upon the effectiveness of these energies depends the creation of material and spiritual wealth—the advancement of civilization—the well-being of man. To be effective, however, they must be understood, they must be organized, they must be coördinated, they must be brought into world-wide coöperation—in one word, they require to be engineered. And so I propose to define engineering to be

*The science and art of directing the time-binding energies of mankind—the civilizing energies of the world—to the advancement of the welfare of man.*[3]

That conception does not represent engineering as it has been practiced in the past nor as it is practiced today. It represents an *ideal* which engineering will

[3] The preamble to the Constitution of the Federated American Engineering Societies says, "Engineering is the science of controlling the forces and of utilizing the materials of nature for the benefit of man, and the art of organizing and directing human activities in connection therewith," and the Federated is dedicated "to the service of the community, state and nation."

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approximate more and more just in proportion as it becomes more and more humanized and enlightened. The ideal is an inspiring one; but it ought not to flatter the vanity of professional engineers; it ought rather to give them a feeling of humility. For consider its spirit and its scope.

Its spirit is not a self-serving spirit nor a class-serving spirit nor any provincial spirit; it is a world-serving spirit—the spirit of devotion to the well-being of all mankind including posterity.

And what is its scope? Is it confined to the kinds of work done today by professional engineers in the name of engineering? It is by no means thus confined; its scope is immeasurably greater; for, over and above such work, which no one could wish to belittle, it embraces whatever may be intelligent, humane, and magnanimous in the promotion of science, in the work of educational leadership, in the conduct of industrial life, in the establishment and administration of justice —in all the affairs of a statesmanship big enough to embrace the world.

I am facing the future, and I say "in all the affairs of statesmanship" because I do not doubt that the affairs of state—which are the affairs of man—will at length be rescued from the hands of "politicians" and be committed to a statesmanship which will be an engineering statesmanship because it will guide itself and the affairs of state in scientific light by scientific means.

### Defining Marks of a Great Engineer

Engineering statesmanship will know enough to know that scientific knowledge cannot be applied to the conduct of human affairs if such knowledge does not exist; it will have sense enough to know also that knowledge which does not exist cannot be suddenly called into existence at the moments when it is needed. Engineering statesmanship will, therefore, be sagacious enough to make ample provision in advance for scientific research; not only for technological research, but, primarily and especially, for that kind of research which does not consciously aim at utility or applications. What kind is that? It is the kind whose "only purpose," in the clear words of President Nichols,[4] "is the discovery of new knowledge without thought of any material benefit to anybody;" it is the kind which Simon Newcomb[5] had in mind when he said that, "The true man of science has no such expression in his vocabulary as 'useful knowledge;'" it is the kind of which Henri Poincaré said that, if there can be "no science for science's sake," there can be "no science;"[6] it is, in a word, the kind of research which springs out of pure scientific curiosity—out of wonder, as Aristotle said—and which, just because it is thus disinterested, just because it seeks the true, is the principal source of the useful also.

The subject of such research will be Nature—non-human nature and human nature—the nature of the non-human world and the nature of man—for we can know nothing else. Engineering statesmanship will have sense enough to know that its work cannot be done without scientific knowledge of both kinds of nature; it will, therefore, provide every means for promoting the advancement of the physical sciences and of those biological sciences that deal with the non-human world; and it will especially provide every means for promoting those researches which have for their aim the understanding of man. I have said "especially" because engineering statesmanship will have sense enough to know that, of all the things it must deal with, man is the supreme reality, and that, therefore, the understanding of man—scientific knowledge of human nature—is absolutely essential to its enterprise.

In view of such considerations, it is easy to see what the defining marks of a great engineer are destined to be. They will not be the marks of mere "efficiency" nor of mere technological knowledge nor of technological skill—they will not be mere engineering technique of any kind, whether "civil" or "mechanical" or "marine" or "architectural" or "sanitary" or "chemical" or "electrical" or "industrial;" these things will be important, as they are now, they will indeed be indispensable, but they will not constitute, and they will not define, the great engineer. The characteristic marks of the great engineer will be four: Magnanimity—Scientific Intelligence—Humanity—Action.

He will be religious and he will be patriotic. "To do good" will be his religion, and his love of country will embrace the world, for he will be the scientific organizer and director of the civilizing energies of the world in the interest of all mankind.

[4] The Inaugural Address of the President of Massachusetts Institute of Technology, *Science* (June 10, 1921).

[5] "Congress of Arts and Science," 1, 137.

[6] "Science and Method," translation by Francis Maitland, 16.

## Federated American Engineering Societies Activities

THE Committee on Procedure of the F. A. E. S. met in New York city on July 14. Both the afternoon and evening sessions were fully attended.

The invitation to send representatives to the Pan-Pacific Commercial Conference in September was accepted. Appointment of a representative to attend the Engineering Congress in Rio de Janeiro in September was authorized. The president was authorized to coöperate with the necessary authorities in appointing a committee of engineers to make a trip to China in the near future to form personal contacts and encourage friendly relations.

The return of patents from the Chemical Foundation to the Alien Property Custodian was considered by the committee and a resolution was addressed to the president requesting that action be delayed until

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representatives of the chemists, chemical engineers and manufacturers, and others could be heard; also that nothing be done which would in any way tend toward the ultimate return to former owners of patents and other property lawfully sequestered and sold to Americans.

Revision of the Mining Laws proposed in H. R. 7736 was approved by the committee and American Engineering Council was directed to use its influence in furthering the passage of the bill subject to committee amendments.

The committee approved the opinion that the following bills were not within the scope covered by the activities of American Engineering Council: Bacharach bill affecting public utilities companies, the Merchant Marine bill, the Trade Associations regulating bill and the Ship Subsidy bill. It approved the principle of the hydraulic laboratory bill but recommended that no special exertion be made in favor of it until a special committee of the Boston Society of Civil Engineers could review the whole subject and advise the Executive Board.

The executive secretary reported that the Engineers and Architects Club of Louisville, Kentucky, had applied for membership in the Federated Societies.

The next meeting of the executive board is to be held in Boston, Sept. 8 and 9.

## Fourth of Income of Country Goes to Three States

THREE states, New York, New Jersey, and Pennsylvania, receive one-fourth of all income in the United States. Twelve southern states, comprising more than 21 per cent. of the population, receive less than 15 per cent. of the total income. On a per capita basis, the people of the Pacific states receive a higher average income than those in any other regional group.

These figures are taken from advance sheets of a report entitled "Distribution of Income by States," prepared by Oswald W. Knauth and soon to be issued by the National Bureau of Economic Research, Inc., 474 West 24th St., New York. The report will form the third volume of a series giving the findings of an exhaustive investigation of income in the United States, on which the staff, composed of Wesley C. Mitchell, Willford I. King, Frederick R. Macaulay and Oswald W. Knauth, has been engaged for more than two years.

New York leads the states of the Union in both aggregate income and per capita income, according to this report.

The aggregate income received in New York in 1919 was $9,047,859,000, or more than one-eighth of the entire income in the United States. At the other end of the scale is Nevada, with a total income of $65,791,000. Pennsylvania ranks second in aggregate income with almost six billion dollars and is followed by Illinois, Ohio, Massachusetts, California, Michigan and Texas, the last with approximately two and one-half billion dollars.

New York, which heads the list of per capita incomes with $874, is closely followed by Nevada, California, Delaware, Wyoming and Massachusetts, all with per capita incomes around $800.

While per capita income in the United States as a whole in 1919 was $627, this report shows that in the region embracing the Pacific states the average was $796 and in the middle Atlantic states it was $783. These high figures are in striking contrast to per capita income of $463 in the south central states and $364 in the east south central states.

The east north central states—Ohio, Indiana, Illinois, Michigan, and Wisconsin—had an income of nearly fifteen billion dollars, which was 22 per cent. of the income of the country, while their population was just one fifth of the nation's. As a group, therefore, their average income of $684 was above that for the whole country.

The average income of the gainfully employed shows variations from the per capita income due to the wide differences in the character of the employment of the population of the various states. South Dakota and New York head the list with just over $2000, while Alabama and Mississippi are both under $900. In Ohio, the average is $1725; in Indiana, $1524; in Illinois, $1889; in Michigan, $1752; and in Wisconsin, $1473.

The variations in the incomes of farmers are well known, but how wide these differences are may be a surprise. Farmers in the Pacific states in 1919 had an average income of over $2800; in the west north central states their average was $2300; in New England, $1160; in the south Atlantic states, $1340; and less than $1000 in the east central states. The highest average income of farmers was found in California, with $3485, and the lowest in certain southern and New England states, where it was less than $1000.

Details are given in the report of the National Bureau of Economic Research, which is especially designed to meet the needs of many investigators who are concerned with the comparative capacity of the various states to bear increased taxes, to buy goods of various sorts, to absorb securities, etc. It also undertakes to analyze the relative importance of agriculture in the different sections of the country.

Income as defined in this report is the money value of all the goods and services produced during the year. The sources on which the estimate is based are the Income Tax Reports, Census Reports, wages data, reports of the Department of Agriculture and statements of corporations.

**War Minerals Relief.**—The "net loss" policy which has been applied in the consideration of all war minerals claims has been overturned by the Secretary of the Interior, who has ruled that actual losses on one property may be allowed even if the owner made profits on a separate operation. This probably makes additional awards in a large number of cases.

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# Anaconda Accidents and Fatalities*

By JOHN L. BOARDMAN

Safety Engineer, Anaconda Copper Mining Co., Butte, Mont.

THE latest metal-mine accident report available for the United States is that of the Bureau of Mines for the calendar year 1919. Quoting from Table 20, p. 53, of that report, we find that there were 468 men killed, 7 permanently totally disabled, 321 permanently partially disabled, 7848 injured seriously (more than 14 days disability), and 23,330 of 1 to 14 days disability.

We have no records to show what the average days lost per case of accident is, but the records for the Anaconda Copper Mining Co. show that, leaving out the fatalities and total permanent disabilities, and counting those in which the lost time was one or more days, the actual days lost due to accidents, for the Butte mines and shops for five years, 1917–1921, were as follows:

*Accident Statistics, Butte Mines and Shops of A. C. M. Co.*

| Year | Accidents | Total Shifts | Rate per 10,000 Shifts | Days Lost | Days Lost Per Accident |
|---|---|---|---|---|---|
| 1917 | 2,661 | 3,169,720 | 8.395 | 26,734 | 10.05 |
| 1918 | 2,765 | 3,545,149 | 7.799 | 39,199 | 14.17 |
| 1919 | 1,381 | 1,853,143 | 7.452 | 22,797 | 16.50 |
| 1920 | 1,376 | 1,879,410 | 7.321 | 20,164 | 14.65 |
| 1921 | 376 | 776,461 | 4.842 | 8,287 | 22.03 |
| Total... | 8,559 | 11,223,883 | 7.625 | 117,981 | 13.80 |

In order to place an economic value on this loss, we will assume that all the 468 fatalities and the 7 total permanently disabled in the United States were compensated for at the rate which applies in the State of Montana, that is, $5000 each, and that the 8169 serious accidents in the United States were compensated for at an average of $70 per case, thus bringing the estimated compensation paid by metal-mining companies in the United States to the enormous total of $2,946,830 for the year 1919.

The figure of $70 per case was obtained by dividing the total amount paid by metal-mining companies under Plan No. 1 of the Montana Compensation Law, for the first five years of its operation, by the total number of serious accidents for those years.

Assuming, also, that the days lost per accident for the total number of metal-mine accidents in the United States were the same as our average, *i.e.*, 14 days each, the total days lost were 31,499 times 14, or 440,986 days. These days, at a wage of $4.25 per day, represent a loss of $1,874,190.50 to the working men in mines of the United States. Thus, the total cash loss, due to accidents in metal mines of the United States for the year 1919, was approximately $4,821,020.

This, however, does not represent the total loss due to accidents; we have not calculated, nor can we figure, the real loss which comes as an after effect of the first loss.

## Real Loss Due to Accidents

The greatest desire of practically all men is to attain financial independence. Every man wishes to establish a home, rear children, and give his dependents the best of everything to be had. Therefore, the moral effect of an injury, which suddenly plunges a man beneath the line of self-sustaining progress toward his goal, into debt and dependence, is so great that it has become one of the main issues upon which radical demands for more pay, shorter hours and higher and more liberal compensation rates have been made. The loss due to strikes, called by agitators who have played up, in their worst light, the figures given above, has been tremendous. Another cost not generally reckoned, but directly due to accidental injury, is that of hiring and breaking in a new man to fill the place formerly occupied by the injured man.

Upon such small things does the course of human lives depend, that an accident to a father might mean the denial of a college education to a son or daughter. Many a mortgage has been foreclosed on a workman's home because financial difficulty began with a three-weeks layoff due to an accident. Many a bad account on the books of the business men would have remained on the other side of the red line but for the financial loss and discouragement of a personal injury.

## Three Classes of Accidents

Statistics in general, and accident statistics in particular, may lead one into various lines of thought, but it is principally the action following the thought that results in progress.

First, there are the scare-head statistics, such as those given, which are intended, of course, to initiate the thought that the subject is worthy of attention; these are followed by statistics giving causes of accidents. Records lead us to believe that there are three general classes of accidents: one due to faulty design

* Presented at meeting of Montana Local Section, Butte, Montana.

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of structures and apparatus, or poor equipment in general; a second, due to the natural hazards of the particular industry under discussion; and a third, due to the carelessness or incompetence of the individual.

The Anaconda Copper Mining Co. has insisted that every apparent source of danger shall be guarded. Thousands of dollars have been spent in the Butte mines in the installation of guard rails, safe manways, grizzlies, heavier lagging, trolley-wire guards, safe construction and location of powder magazines, guards on moving machinery, high safety factors on hoisting ropes, over-winding devices, and so forth.

The class called the natural hazard of the industry is, to some extent, a composite of the other two. We cannot entirely escape the accidents due to the natural hazard, but a close study of accident causes will show that very few accidents are chargeable under this head.

The third and most important general class contains the accidents due to carelessness or incompetence. Various safety bureaus, safety engineers and statisticians have attempted to fix the proportion of total accidents chargeable to this class. These authorities say it contains from 80 to 90 per cent. of all accidents. This statement is borne out by our own experience, both in careful classification of accidents and in a safety drive of four weeks, in which, by means of an advertising campaign, we were able to keep before each individual, throughout each day, the thought of accident prevention, and which resulted in a decrease from 23.499 accidents per 10,000 shifts, for the corresponding period of a year previous, to only 9.114 for the period of the drive.

### Continued Effort Necessary in Safety Work

There is no room for doubt as to the cause of a high percentage of our accidents; they are directly due to carelessness or incompetence of the men. However, great care must be exercised at all times to prevent accidents from causes that might show carelessness or negligence on the part of bosses or the company, because one such accident might cause a greater amount of criticism than all the others.

Many mining companies have spent large sums of money to improve working conditions along safety lines and have found that although accident rates dropped appreciably at the first, they have gradually risen almost to their former height. The officials of these companies, in some cases, are inclined to feel discouraged; but this condition only points to the true solution of the problem. When such work is new, it is the subject of comment on every tongue, talked of by bosses at every meeting, and argued pro and con by every assemblage of workmen, but after the work of installing guards, changing methods and placing danger signs has been completed, other things crowd the subject out. The effort loses its vividness and soon these things are taken as a matter of course.

It is no more reasonable to expect a low accident rate to result solely from the installation of safe machinery and methods than it is to expect results from the installation of a modern hoisting engine if no engineer is provided to run it. Since 80 to 90 per cent. of all accidents are directly due to thoughtlessness or incompetence on the part of the injured man, or his fellow workmen, we will never realize the full benefit from our efforts in adopting safety equipment and methods until every man on the job who is responsible for over-seeing work has exerted his full effort in keeping before the men under him the thought of doing their work safely. The ability to coördinate the mind with the physical body is the distinction between a first-class workman and a mediocre, or poor, workman, in any line of work.

### Suggestive Teaching Will Overcome Incompetence

We ought not to use the word carelessness in describing the cause of accidents; men do care whether they are injured, and rarely do we find a man who deliberately attempts to cause an accident. We will have to abandon this word carelessness, and use the word thoughtlessness, or preferably, incompetence, in ascribing the cause of an accident. Rarely do we find an injury happening to a man who was actually thinking about his work at the time of the accident; and almost as rarely do we find the ordinary man thinking about his work at any time.

In modern organizations where authority is becoming more and more centralized the boss or foreman is losing part of his old-time authority, and this is being replaced by a new duty, that of teaching. Many foremen and bosses complain that the high accident rate is due to ignorance or incompetence of the present available class of labor. This is, in some measure, a reflection on the ability of the foreman or boss. What are bosses for, if not to teach the men under them how best to perform their work?

It is distinctly the duty of bosses and foremen, as well as engineers, to do all in their power to carry on this safety propaganda. It costs less effort to pleasantly, but sincerely, warn a man of danger or to instruct him as to a better way to perform work, than to criticise, disparage, or discharge him. The scoffer, the man who says, "I have done it that way for 30 years and have not been hurt yet," is sure to appear occasionally, but most men are amenable to suggestion regarding safety. Constant dropping wears away the stone; and constant propaganda and suggestive teaching reduces accident rates.

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**Hydraulic Laboratories.**—A Directory of Hydraulic Laboratories in the United States has been compiled under the direction of the Hydraulic Research Committee of Engineering Foundations, the members of which are J. Waldo Smith and Silas H. Woodard. The book has 84 pages, 7 by 10 in., and contains information about 49 laboratories in engineering colleges, industrial establishments and governmental bureaus. For copies of the Directory, address Alfred D. Flinn, Secretary of Engineering Foundation, 29 West 39th St., New York.

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# An Old Japanese Converting Process

By IICHIRO OMORI

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THE Mabuki process, a Japanese hearth process for the treatment of matte, uses the same principle as the Bessemer steel process. The only difference between the two is that in the Mabuki process a hearth furnace, not a converter, is used.

Though the hearth is not as good as the converter, the first cost is very low and the capacity is comparatively small; so the process is most suitable for smelters having a small production. To construct the hearth, an excavation, 6 ft. in each dimension, is made in the ground and a drainage channel is dug at the bottom. Then all side walls are faced with stone or slag brick and the cavity is filled with fireclay or brasque, except the hearth at the top.

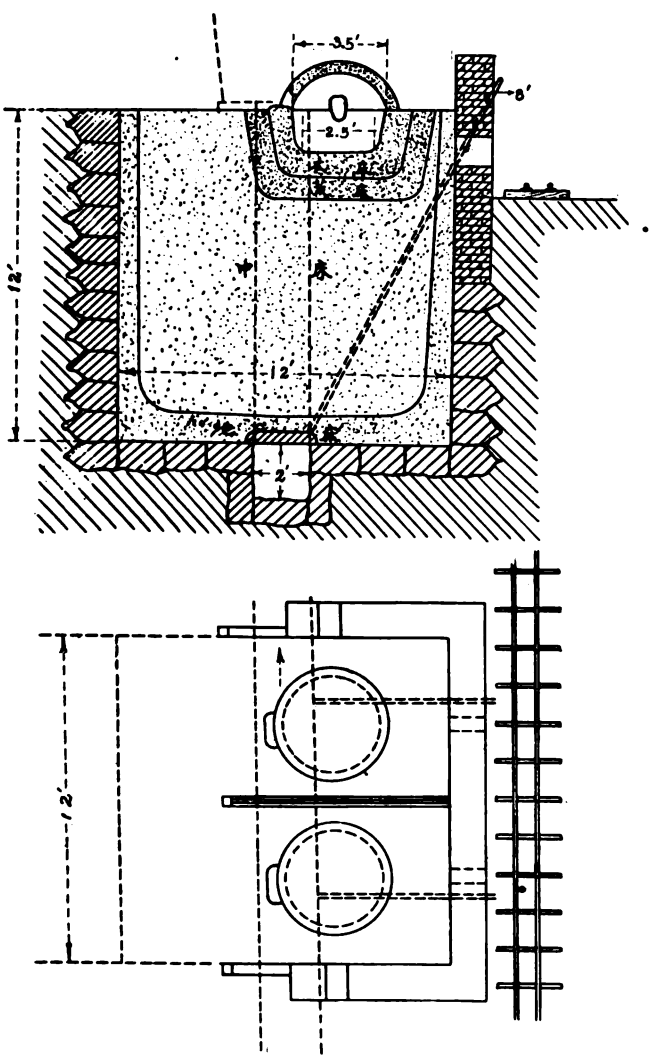


FIG. 1.—PLAN AND SECTION OF HEARTH.

The hearth is 3 ft. in diameter and 1½ ft. deep and is usually semispherical in form. It has a temporary cover of clay mixed with straw; in the front is a working mouth and at one side an opening for the tuyere. A block of clayey ore at the mouth is called "Hashiri." This block acts as the flux and also serves as a rest for tools during the operation. The composition of the clayey ore is about as follows:

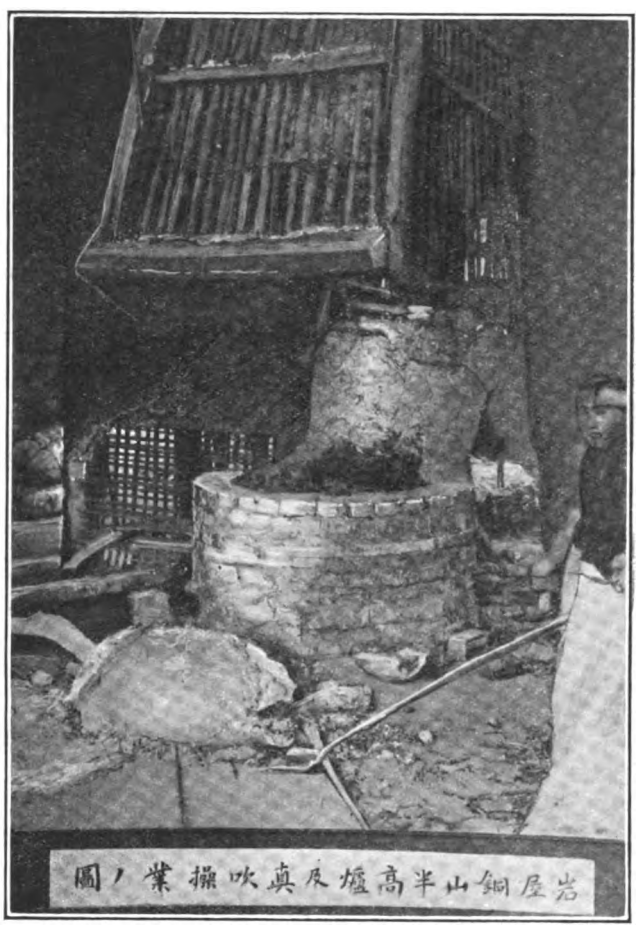

FIG. 2.—HEARTH USED IN MABUKI PROCESS.

| Cu, Per Cent. | Fe, Per Cent. | $SiO_2$, Per Cent. | $Al_2O_3$, Per Cent. |
|---|---|---|---|
| 0.30 | 4.38 | 65.37 | 14.23 |
| 1.15 | 12.32 | 45.27 | 13.98 |

The tuyere is made of sheet iron and is covered with an inch of clayey ore. The nozzle forms an angle of 30° with the surface of matte charged in the hearth and is 2½ in. in diameter. The first cost of the hearth is $15 to $17.50. Root's blower or Turbo blower is

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used. No. 4 Root blower will serve six hearths. The maximum pressure of the blast is 40 mm.

### Blowing In and Charging Stage

At first, the hearth is thoroughly dried and 1½ ton of molten matte containing 30 to 40 per cent. of copper is charged; next charcoal is put on the matte in the form of a semisphere and then the entire charge is covered with 4 in. of clayey ore mixed with straw, which becomes a good cover when it is dried by the heat of the charge. A light blast, about 2 or 3 mm., is used during this stage. When slag floats on the surface, it is skimmed

Table 1.—*Composition of Ores, Mattes, and Slags at Copper Mines in Japan*

Ore

| | Au | Ag, | Cu, Per Cent. | Pb, Per Cent. | Zn, Per Cent. | Fe, Per Cent. | $SiO_2$, Per Cent. | $Al_2O_3$, Per Cent. | $BaSO_4$, Per Cent. | S, Per Cent. | CaO, Per Cent. | MgO, Per Cent. | Mn, Per Cent. | As, Per Cent. | Bi, Per Cent. | Sn, Per Cent. | Ni, Per Cent. | Co, Per Cent. | Sb, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black sulfide ore at Kosaka | 0.00015 | 0.02 | 2.00 | 2.40 | 12.60 | 10.87 | 5.12 | 3.03 | 39.12 | 21.51 | | | | | | | | | |
| Chalcopyrites at Ashio | 0.00004 | 0.014 | 13.66 | 0.12 | 1.57 | 26.25 | 24.18 | 4.82 | | 21.46 | 1.68 | 0.28 | 0.15 | 2.16 | 0.081 | | | | |
| Cupriferous pyrites at Hidachi | | | 3.23 | | 1.38 | 28.89 | | 2.09 | 1.01 | 28.00 | 1.18 | 1.93 | | | | | | | |
| Cupriferous pyrites at Besshi | 0.00007 | 0.00037 | 2.36 | 0.07 | 0.41 | 42.41 | 4.10 | 0.76 | | 49.22 | 0.27 | 0.091 | 0.049 | 0.024 | 0.074 | 0.013 | 0.017 | tr | 0.074 |

Mattes

| | Cu, Per Cent. | Pb, Per Cent. | Fe, Per Cent. | Zn, Per Cent. | $SiO_2$, Per Cent. | $Al_2O_3$, Per Cent. | S, Per Cent. | CaO, Per Cent. | MgO, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|
| Saganoseki smelter | 18.00 | 1.56 | 48.83 | 1.94 | 0.28 | 0.64 | 27.15 | 0.50 | 0.19 |
| Hidachi mine | 21.50 | 0.25 | 46.45 | 2.20 | 0.20 | 0.25 | 24.37 | 0.27 | 0.24 |
| Ikuno mine | 37.10 | 0.80 | 34.40 | 2.10 | | | 26.70 | 0.10 | |
| Hibi smelter | 30.13 | | 38.70 | | | | 22.37 | | |

Mattes Produced by the Concentrating Smelting in Blast Furnace

| | Cu, Per Cent. | Pb, Per Cent. | Fe, Per Cent. | Zn, Per Cent. | $SiO_2$, Per Cent. | $Al_2O_3$, Per Cent. | S, Per Cent. | CaO, Per Cent. | MgO, Per Cent. | MnO, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|
| Saganoseki | 41.51 | 3.07 | 24.75 | 3.71 | 0.50 | 0.50 | 23.00 | 0.62 | 0.27 | tr. |
| Hidachi | 35.58 | 0.51 | 34.66 | 1.27 | 0.28 | 0.02 | 25.51 | 0.34 | 0.25 | 0.34 |

Slags Produced in the Blast-furnace Smelting of Ore

| | Cu, Per Cent. | Pb, Per Cent. | Fe, Per Cent. | Zn, Per Cent. | $SiO_2$, Per Cent. | $Al_2O_3$, Per Cent. | S, Per Cent. | CaO, Per Cent. | MgO, Per Cent. | MnO, Per Cent. | $BaSO_4$, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Saganoseki | 0.19 | 0.55 | 26.32 | 4.53 | 35.90 | 7.14 | 0.79 | 12.26 | 1.63 | 0.25 | |
| Hidachi | 0.22 | | 25.98 | 0.76 | 37.23 | 6.58 | 0.94 | 16.80 | 2.56 | 0.40 | 0.34 |
| Ikuno | 0.30 | tr. | 29.40 | 3.08 | | 4.70 | | 7.30 | | | |
| Hibi | 0.41 | | 32.92 | | 29.76 | | 0.93 | 11.50 | | | |

Table 2.—*Slags Produced in Blast-furnace Smelting of Copper Ore*

| | Cu, Per Cent. | Pb, Per Cent. | Fe, Per Cent. | Zn, Per Cent. | $SiO_2$, Per Cent. | $Al_2O_3$, Per Cent. | S, Per Cent. | CaO, Per Cent. | MgO, Per Cent. | MnO, Per Cent. | $BaSO_4$, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Saganoseki | 0.19 | 0.55 | 26.32 | 4.53 | 35.90 | 7.14 | 0.79 | 12.26 | 1.63 | 0.25 | |
| Hidachi | 0.22 | | 25.98 | 0.76 | 37.23 | 6.58 | 0.94 | 16.80 | 2.56 | 0.40 | 0.34 |
| Ikuno | 0.30 | tr. | 29.40 | 3.08 | | 4.70 | | 7.30 | | | |
| Hibi | 0.41 | | 32.92 | | 29.76 | | 0.93 | 11.50 | | | |

Converter Copper

| | Cu, Per Cent. | Pb, Per Cent. | Zn, Per Cent. | Ni, Per Cent. | Co, Per Cent. | Fe, Per Cent. | As, Per Cent. | Sb, Per Cent. | Se, Per Cent. | S, Per Cent. | Ca, Per Cent. | Mg, Per Cent. | Al, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hidachi | 98.95 | 0.06 | 0.01 | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.09 | 0.11 | 0.03 | 0.01 | 0.01 |
| Kosaka | 98.80 | 0.09 | 0.013 | | tr. | 0.019 | | | | tr. | tr. | 0.016 | |

Mabuki Copper

| | Cu, Per Cent. | Fe, Per Cent. | Zn, Per Cent. | Ni, Per Cent. | $Al_2O_3$, Per Cent. | Se, Per Cent. | S, Per Cent. | Pb, Per Cent. | As, Per Cent. | Sb, Per Cent. | Bi, Per Cent. | Sn, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Saganoseki | 97.37 | 0.0218 | 0.0563 | 0.2233 | 0.0079 | 0.034 | 0.8299 | 0.9578 | 0.0245 | 0.149 | 0.0125 | 0.067 |

Converter Slag

| | Cu, Per Cent. | Pb, Per Cent. | Fe, Per Cent. | Zn, Per Cent. | $SiO_2$, Per Cent. | S, Per Cent. | CaO, Per Cent. | MgO, Per Cent. | $Al_2O_3$, Per Cent. | As-Sb, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|
| Hidachi | 1.860 | 0.25 | 46.46 | 1.73 | 28.60 | 0.81 | 0.99 | 1.090 | 2.26 | |
| Shisakajima | 1.378 | | 47.914 | | 26.120 | 1.22 | 0.36 | 0.232 | 4.00 | |

Mabuki Slag

| | Cu, Per Cent. | Au, Per Cent. | Ag, Kilogram | S, Per Cent. | FeO, Per Cent. | $SiO_2$, Per Cent. | ZnO, Per Cent. | Pb, Per Cent. | CaO, Per Cent. | $Al_2O_3$, Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|
| Saganoseki | 7.6 | tr. | 0.265 | 3.4 | 61.2 | 15.6 | 5.3 | 0.3 | 0.4 | 4.4 |

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off. About 2 hr. is required for this blowing operation.

The blast pressure is then increased to 40 mm.; after 2 hr. slag floats on the surface and is skimmed off. A new charge of molten matte is added and the operations are repeated about eight or nine times, until 4 tons of matte have been charged. The time required for this stage is about 10 hours.

TABLE 3.—*Typical Blast Furnaces of Copper Smelter in Japan*

| Mine | Furnace | Diameter at Tuyere Level | Center of Tuyere to Feed Floor | Center of Tuyere to Bottom of Furnace | Diameter of Tuyere | No. of Tuyere | Central Distance of Tuyeres | Height of Water Jacket |
|---|---|---|---|---|---|---|---|---|
| Ashio | No. 3 | 3′ 6″ × 15′ | 11′ 3″ | 2′ 6″ | 4½″ | 24 | 13 5/16″ | 8′ |
| | No. 4 | 3′ 6″ × 15′ | 11′ 3″ | 3′ ¾″ | 6″ | 24 | 15″ | 5′ |
| | No. 5 | 3′ 3″ × 11′ | 7′ 8″ | 2′ 11½″ | 6″ | 16 | 15¾″ | 3′ 7¼″ |
| Hidachi | No. 5, 6, 7 | 4′ × 20′ | 10′ 2″ | 2′ 8″ | 6″ | 24 | 18″ | 6′ |
| | No. 8, 9, 10 | 4′ × 15′ | 10′ 6″ | 2′ 3″ | 6″ | 20 | 18″ | 5′ 6″ |
| Shisakajima | No. 8 | 4′ × 12′ | 14′ | 3′ 3½″ | 6″ | 16 | 18″ | 6′ |
| | No. 9, 10, 11 | 4′ × 24′ | 12′ | 3′ 3½″ | 6″ | 32 | 18″ | 6′ |
| Kosaka | No. 6 | 4′ × 19′ | 11′ 6″ | 3′ | 6″ | 24 | 17″ | 2′ 9½″ |
| | No. 7 | 4′ × 24′ | 14′ 6″ | 3′ 2½″ | 6″ | 28 | 19″ | 4′ |
| Osaruzawa | No. 3 | 3′ 9″ × 8′ | 15′ 6″ | 3′ | 3″ | 12 | 15″ | 10′ |
| Ikuno | No. 3 | 3′ 4″ × 8′ 5″ | 12′ 6″ | 2′ 5″ | 6″ | 10 | 20″ | 6′ 6″ |
| Ogoya | No. 2 | Dia. 3′ 6″ | 7′ 6″ | 2′ 6″ | 4½″ | 6 | 30″ | |
| Makimine | | Dia. 3′ 6″ | 6′ 6″ | 2′ 5½″ | 4″ | 6 | 30″ | |
| Taishō | No. 2 | 4′ 3″ × 10′ | 11′ 6″ | | 5″ | 8 | 9″ | 5′ 6″ |
| Yoshioka | | 4′ × 10′ | 13′ 5½″ | 1′ 11″ | 6″ | 16 | 15″ | 7′ |
| Abeshiro | | 3′ 6″ × 14′ | 13′ ½″ | 1′ 1¼″ | 4½″ | 24 | 13¼″ | 4′ |
| Arakawa | | 4′ × 8′ | 7′ 8″ | | 6″ | 16 | 12″ | |
| Ani | | 3′ × 8′ | 11′ 3″ | 2′ 11″ | 4″ | 11 | 18″ | 6′ |
| Kabusan | No. 1 | 3′ 6″ × 16′ | 10′ 6″ | 1′ 8″ | 5″ | 24 | 15″ | 3′ 6″ |
| Kunitomi | No. 4 | 3′ 6″ × 14′ | 13′ ½″ | 2′ 3″ | 4½″ | 24 | 13¼″ | 3′ 6″ |
| Nagamatsu | | 3′ 6″ × 8′ 10″ | 12′ 6″ | 2′ 6″ | 4½″ | 12 | 13 15/16″ | 4′ 6″ |
| Sashima | No. 5 | 3′ × 10′ | 12′ 6″ | 2′ 7″ | 6″ | 16 | 14″ | 4′ |
| Kinkaseki | No. 5 | 3′ × 13′ | 12′ 3″ | 2′ 7″ | 5″ | 28 | 11″ | 6′ |
| Chinnanpo | | 3′ 6″ × 16′ | 10′ 5″ | 2′ 6″ | 5″ | 24 | 15″ | 5′ |
| Saganoseki | No. 1, 2, 3 | 4′ × 26′ | 13′ 9″ | 1′ 3″ | 6″ | 40 | 1–3″ | 5′ 5″ |

### SLAGGING STAGES

Some charcoal is added to the hearth and all iron sulfide is oxidized by the blast. The FeO produced combines with the $SiO_2$ contained in the cover and the wall of the hearth to form slag; this is skimmed off until pure $Cu_2S$ remains in the hearth and the surface of the matte seems very clear. The time required for this stage is about 1 or 2 hours.

### OXIDIZING STAGE

The inclination of the tuyere is changed to 40° but the end of the nozzle is always kept 5 in. from the surface of the matte. No fuel is added during this stage and the blast is used only to oxidize $Cu_2S$ to copper oxides and $SO_2$. Therefore the matte becomes pasty and is made to adhere to the wall of the hearth opposite to the tuyere. The time required for this stage is about 8 hours.

### REDUCING STAGE

A large amount of charcoal is now added to produce heat and to reduce copper oxides to metallic copper and the metal again becomes liquid. Although nearly all the iron was slagged off during the slagging stage, a small amount of rich slag is now produced; this is scraped out and the copper is poured from the tapping hole at the back and cast into ingots. The time required for this stage is about 6 hr. and the total time required for one operation of this process is 25 to 30 hours.

The amount of charcoal consumed is 2 to 4 per cent. of the matte. The extraction in one operation is 70 to 80 per cent. of the total copper in the matte; but the slag and residue are retreated and the copper contained therein is recovered; so the real loss of copper is very small. Two men per shift are employed for each hearth. The cost is $4 to $7 per ton of copper produced, while 98 to 99 per cent. copper is produced.

## Sampling and Estimating on the Menominee Range*

BY J. F. WOLFF†, DULUTH, MINN.

THE iron formation of the Menominee Range has been folded into a series of very close pitching synclines and anticlines, minor folds of many orders being included in the major folds. The pitching synclines have been particularly favorable places for the circulation of ground waters which in these troughs have developed orebodies by leaching out the silica in the iron formation and oxidizing and concentrating ferrous iron compounds in the rocks.

The iron formation of this area in interbedded with and has interbedded in it certain slate or slaty layers which, in addition to the foot wall of the iron formation

* Read at February meeting of A. I. M. E., but not published in pamphlet form.

† Mining Engineer, Oliver Iron Mining Co.

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proper, act as impervious layers in the pitching troughs, to direct and control the flow of underground waters. In most places, the entire iron formation in a structural trough is not altered into iron ore; the orebody may be lense-shaped, exhibiting no folding in its layers, outline or shape, but almost without exception such bodies have been developed in folds and because of the influence of folds, and structurally they occupy only one limb of a fold. Many orebodies occupy the entire trough of a minor fold and the structure of the fold can be traced throughout the orebody.

Orebodies in this area vary in width from a score of feet to a few hundred feet, depending on structure and point of measurement in a trough; in length from a few hundred feet to more than a half mile; and some are known to extend to a depth of more than 1500 ft. The tonnage in individual orebodies varies from a few thousand to several million tons.

As in other parts of the Lake Superior iron district, the methods used in estimating ore tonnages depend much on the way in which the ore has been proved. If it has been proved by diamond drilling, the tonnage is estimated from geologic cross-sections of the drill holes. If it is proved and blocked out by underground workings, the plan area and average depth method is used, as described for Mesabi[1] and Gogebic[2] Range orebodies. Average analyses of the ore are computed as described for those ranges, also.

Owing to the geologic conditions in this area, either drilling or mine development must be complete enough to allow the engineer to outline the structure and the limits of the orebody, in order to determine the total tonnage in the body with any degree of accuracy. No arbitrary limits are adopted in the district in assuming ore to extend beyond proved ore either in drill holes or drifts. Such assumptions, if necessary, are determined by the geologic conditions present. It is uncommon to assume ore to continue more than 100 ft. below a bottom level or beyond an outside drill hole. In estimating the high-grade ores, 10 cu. ft. per long ton is used; 11 cu. ft. for the lower grade ores of the old Menominee Range proper, and 12 cu. ft. for Iron River, Crystal Falls and other ores. Reductions of 10 per cent for rock in orebody and 10 per cent for mining loss are customary.

## Respirators in Noxious Fumes

THE development of a pocket canister or respirator which will largely alleviate the discomfort to which engine crews are subjected from the presence of sulfurous locomotive smoke when passing through railroad tunnels is announced by the United States Bureau of Mines.

The tests made in developing this respirator represent one phase of the work carried on by the gas-mask laboratory at Pittsburgh, Pa. For many years the Bureau has been making experiments to improve and perfect self-contained oxygen breathing apparatus for rescue work at mine fires or explosions, and it was called on, early in the war, to take a large part in the development of the Army gas mask.

More recently, it has investigated the Army mask to determine whether or not that type could be modified so as to be of service in work about smelters, blast furnaces, or similar industrial operations, or possibly even about mines. This investigation has shown that the Army mask does not afford protection against all gases met in industrial life. It does not protect against carbon monoxide, nor against such common industrial gases as illuminating gas, natural gas, ammonia, and the products of combustion found in burning buildings. The Bureau has sought to impress on the public the limitations of the Army gas mask and at the same time to develop special types of masks suitable for different industries or occupations.

Details of the experiments are given in *Technical Paper* 292.

## A British Engineering Joint Council

PROPOSALS for closer coöperation amongst the leading engineering institutions, which have recently been under consideration, have now received the approval of the institutions whose representatives met in conference, namely, the Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects and Institution of Electrical Engineers; and an Engineering Joint Council composed of representatives of these bodies has been formed.

The objects of the Joint Council will be, among others to improve the status of engineers, to secure the better utilization of their services in the country's interests, and the appointment of properly qualified individuals to responsible engineering positions, and to prevent the unnecessary duplication of activities. At a later stage the number of bodies represented on the Joint Council may be increased.—London *Times*.

## Metallurgy at Carnegie Institute of Technology

CARNEGIE Institute of Technology at Pittsburgh has been selected by the United States Naval Academy at Annapolis to give advanced courses in metallurgy to its graduate officers. The institution is the only school in the country chosen for this work, and its selection is a tribute to the high standard of its engineering work.

Beginning next September, the Naval Academy will send two ordnance officers for a year's study in advanced metallurgy, with some studies in electricity and physical chemistry. Other groups of graduate officers are assigned each year to various colleges or universities to study along specialized lines.

[1] Vide p. 41.
[2] Vide p. 45.

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# The Engineer the New Industrial Leader*

By DEXTER S. KIMBALL

Vice-president of the American Engineering Council and President of the American Society of Mechanical Engineers

THE ease and promptness with which the public as a whole becomes accustomed to and takes advantage of the work of the engineer, using the term in a broad sense, is almost startling. Surprise at, and fear of radical innovations in transportation and private service quickly give way to *blasé* indifference, followed instantly by all manner of criticism that these things are not better constructed and managed. Does the street car stop a few minutes on a switch?—summon the State Commission. Is the Overland Express fifteen minutes late on a three thousand mile run?—Congress is memorialized to make the great railroad companies attend to their business. Does central not respond instantly when we take down the telephone receiver?—anathema!! Do the electric lights go out for a minute or so?—the darkness is illuminated by caustic sarcasm and other kinds of spoken English consigning all engineering and engineers to perdition; everyone apparently forgetting how steep the hills were before the days of street cars, how far away San Francisco was before the days of the locomotive, the telegraph and telephone, and how difficult it must have been to study by the light of a tallow candle.

## Dissatisfaction First Step in Progress

These little outbursts should not be construed (as they are by some people) as indicating a lack of appreciation of the work of the engineer. They are an integral part of the influence that makes for progress. The world in a way has always obtained as much engineering talent as it demanded. It is true that the engineer and inventor have had a tremendous influence in changing man's environment and in making this old earth comfortable and more habitable; but it is also true that these same engineers are, to a large extent, products of their own surroundings; and much of their progress has been made by supplying wants created by the public. It is a case of action and reaction; a Burroughs adding machine would be of little use to an Eskimo except as old iron. Criticism is a part of progress.

I fully believe the first stone ax was ridiculed and criticised by the cave dwellers; probably because it required two blows with it to finish an adversary; and some years from now when the flying machine from London to New York shall be ten minutes late on a forty-eight hour run people will be found petitioning the International Supervisors of Flying Machines to compel the owners to put on another propellor or another pair of wings and two tails so that the service may be prompt; at least I hope they will, for dissatisfaction is the first step in progress.

## Molding Ideals Greatest Service to Nation

If the engineer has not been appreciated as much as some other classes of men it is because his service to humanity has not been the highest. The men who render the greatest service to any nation are those who mold its ideals, and the philosopher and the poet will continue to wear the bays as long as they lead in this line. True, the work of the engineer has made it possible for us to realize more fully our ideals if we could only take full advantage of the productive processes which he has developed and the leisure that should result therefrom; for every day it becomes clearer that highest mental and moral development rest primarily on material prosperity. It is difficult to be high minded and hungry at the same time.

Every calling becomes of greater service and rises in popular estimation as it lifts itself from the mire of empiricism and rests its work on the solid ground of science. The tendency to do this is present in all lines of human endeavor where such a basis is obtainable. Medicine and engineering and similar professions have increased their usefulness and prestige in proportion as the chemist, the physicist, the anatomist, and other workers in pure sciences have furnished scientific facts and as those professions have been able to apply them. At the present moment agriculture is rapidly throwing away its old guesswork processes and will shortly emerge as a scientific profession comparable with these others.

The engineer most naturally applied his scientific method to constructive engineering and it has become second nature with him to collect data, to analyze, and to plan work and predict results on this solid basis,

* A message to the engineers of America, broadcast from the General Electric Station, Schenectady, N. Y. The address was heard at points as widely distant as San Francisco, Havana and the City of Mexico.

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but the administration of modern industry has come to require a considerable knowledge of constructive art, and the natural tendency to seek a solution of the problems of administration on the basis of accumulated knowledge rather than on an empirical basis has made one opportunity for the engineer that has carried him far afield and brought him closely in touch with the administrative side of both private and national affairs.

To this new field, quite naturally, he has brought the analytical methods of his calling, and the art of management bids fair to be placed on a much more rational basis because of his labors in this new field of activity. Compilation, analysis, prediction, are the methods he is employing, and stripped of all its technical terms and high-sounding titles, so-called efficiency engineering or scientific management and its correlated branches represent an effort to raise business management of all kinds from the vague empirical basis on which it now rests and place it on a scientific footing comparable with modern constructive processes. The progress which this movement makes will depend, as before noted, not on the effectiveness of these methods alone but on the reactive influences which it meets with or awakens.

Efficiency is not the sole criterion by which industrial phenomena are finally to be judged. Whether we will it or not, industry is being looked upon more and more as a means of supporting human existence and less as a means of creating individual or coöperative dividends. The most efficient kind of factory for the creating of dividends would be equipped with the highest order of labor-saving machinery and management and operated by slaves.

### New Industrial Philosophy Needed

As we move farther and farther away from this extreme ideal, so we shall become more and more critical of processes and methods of production. It is going to be a nice problem in social and political organization to reconcile the many conflicting reactions, and the full import of the movement will be more and more appreciated as our natural resources become more depleted and the struggle for existence becomes keener.

The influence of this new study on the engineer himself will be far reaching, for he must draw his basic facts for this work not only from his own field of engineering but also from economics, accounting, psychology, and other sciences which heretofore he has known little or nothing about, or has ignored; and this has brought him very close to the pivotal problem of our civilization, namely, the fair and equitable distribution of the wealth which he is so instrumental in creating.

If he can master the fundamental truths that lie at the bottom of the problem or if he will have the wisdom and foresight to call to his aid the masters of thought in these lines, it is not beyond reason to hope that as he has conquered the problems of production and is now conquering the problem of administration he may evolve from his riper experience in these fields a solution of the remaining problem which will be satisfactory to all. It is apparent that the solutions already offered fail to satisfy; but it by no means follows that these are the only possible solutions any more than the old methods of management were the only ones possible.

In fact, as we look back even a few years, the philosophies of engineering and manufacturing as then practiced seem very inadequate indeed; and the theories of management of yesterday are rapidly passing into obsolescence. We are sadly in need of a new type of industrial philosophy and new methods of distribution. We are in need of a new type of industrial leader; and I believe that if he comes at all in the near future, he will come from the ranks of the engineer, again using the term in the broadest sense. It is true that other classes of men are familiar with and use the engineer's methods, but he is going to have a particularly advantageous position from which to attack this problem, for the near future will see him a dominant figure in industrial management where he will meet the problem at first hand.

Here is his opportunity. It is hardly likely that any one man will be able to solve this difficult problem, and if it is solved it will probably be the work of many brains, but the man who first points out the way to a solution will not need to envy any man his glory for posterity will surely place him in the ranks of the immortals.

I have every confidence that the engineer will rise to this opportunity and there are many things that these ideals are stirring in the minds of forward-looking engineers. It is with no small gratification that we see the elevation of our past-president, James Hartness, to the gubernatorial chair of his own state and see Mr. Hoover, an engineer by training and experience, invited to enter the cabinet of President Harding. These are pioneer workers in a field where the lawyer and the politician have long reigned supreme and their stewardship will be watched by all engineers and others with great interest. It is an auspicious beginning that should hearten all who believe in the application of scientific methods to all problems of human existence.

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## Accountant's Control of Factors in Economic Situation

ASSERTING that no continuous downward trend in prices can be brought about until the workers know production costs, Robert B. Wolf, a member of the Committee on Waste of the Federated American Engineering Societies, in a statement on Accounting for Man's Economic Use of Time as a Means to Reduce Waste, declares that the accountant today holds the key to the situation, as he can either release great creative power for constructive purposes, or produce repressive conditions which, by keeping men in ignorance, will not only make for indifference, but will actually produce a desire to destroy the existing order.

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# Sampling and Estimating Lake Superior Iron Ores*

By J. F. WOLFF, E. L. DERBY AND W. A. COLE

Geologist, Cleveland-Cliffs Iron Co., Ishpeming, Mich.; Chief Engineer, E. J. Longyear Co., Minneapolis, Minn.

EXPLORATION of Lake Superior iron ores is done principally by drilling. The soft iron ores are churn drilled and the harder ores are diamond drilled. In exploratory work in the harder formations, where the diamond drill is used, the sample comprises both core and cuttings. The care given in handling and preserving the core depends on the importance that may be attached to certain characteristic strata in different formations. The following instructions for the care of core samples are issued by the Oglebay Norton Co. for diamond drill work done for them on the Gogebic Range of Michigan:

The driller shall be careful upon removing the core from the core-barrel to keep the core in exact order. Not only should the pieces of core be kept in exact relation to each other, but care should be used not to turn them end for end. Core should be placed in the core-box from left to right in each row. Each drill should be furnished with small, hinged cover core-boxes, and each drill should be well supplied with empty boxes. Core remaining at the drill when the drillers are not working should be locked up. The practice of picking sample pieces of core and carrying them away from the drill to be examined in better light, or shown to someone else, is unnecessary and prohibited. The reason for this is that these pieces are seldom returned to the core-boxes and valuable information or "markers" may be lost. If the inspector suspects that a critical point is reached in the drilling and he cannot determine at the drill, he should remove the entire core-box and see that the drill is immediately furnished with an empty core-box.

It is customary to split the core longitudinally so that one-half may be ground to a pulp for analysis and the other half may be kept for future inspection. The core should be filed in permanent core-boxes, properly labelled, if the core is to be kept in exact order as taken from the core-barrel. Otherwise, it is often filed in tin boxes in the way that sludge samples are filed.

To obtain the average analysis, the core and cutting samples obtained in the same run are analyzed separately and the analyses are combined in the proper ratio.

## Sampling Underground Development Work

Drifts and cross-cuts in iron-ore deposits are usually sampled in 20- or 25-ft. sections. The number of places in which material is taken for a sample of each section depends on the character of the ore formation. The samples are generally taken as follows:

1. Each section is sampled at four stations. Sections 1 and 3 are on one side of the drift, and immediately opposite are stations 2 and 4. The relative position of the stations is maintained in each succeeding section. The sample representing each section is obtained by cutting a groove at each station, 3 in. wide and 2 in. deep, across the entire face of the ore at right angles to the formation.

2. Grooves are cut between each set of timbers, 5-ft. intervals, on opposite sides of the drift.

The material is caught in a pan or box, as the grooving is done, and a proper amount is taken, after mixing for the sample.

Raises, winzes, etc. are sampled in 5-ft. sections where the ore is uniform. If rock or lean ore occurs in the same 5-ft. interval, representative samples are taken of each material. If the ore lies in nearly horizontal strata, opposite or adjacent walls are sampled; otherwise the four walls are sampled. The walls to be sampled are first cleaned and a vertical groove, 3 in. wide and 2 in. deep, is cut down the middle of the wall from top to bottom of each 5-ft. section. The material thus removed is caught in a pan or box and the samples from the two or four cuts, as the case may be, are combined.

## Iron-ore Estimates

There are certain empirical rules for estimating but each deposit offers special problems for the engineer to solve. In all estimates the main factor influencing the results is the personal element, good judgment.

Ore estimating is a problem in structural geology combined with engineering accuracy. In the Lake Superior region, iron ores are the result of sub-surface alterations of richer layers of the iron-bearing rocks and are localized at places where these alterations have been most effective. The structural features that are factors in such secondary concentration of iron ores, and therefore determine the shapes of the ore deposits, are joints, faults, folds, intersection by igneous rocks, impervious sedimentary layers or igneous masses within or below the iron-bearing formations, and area of exposure.

In the Mesabi district of Minnesota, the localization of the ores by fractures in the iron-bearing formations appears to be the outstanding feature. Other structural features of prime importance, on the Mesabi, are the area of exposure and the occurrence of the iron

*Read at February Meeting of A. I. M. E., but not published in pamphlet form.

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formation in characteristic horizons, as correlated by the engineers of the Oliver Iron Mining Company.

In other Lake Superior iron-ore districts, the structural feature that is more conspicuous in determining the location of ores within certain portions of the iron formation is the impervious basement, usually having the configuration of a pitching trough. Impervious basements for the orebodies may be formed (1) by the intersection of the foot-wall quartzite with an igneous dike, as in the Gogebic district; (2) by irregular intrusive masses of basic igneous rock, as in the Marquette district; (3) by dolomite formation, as in the Menominee district; (4) by slate, as at the lower horizons of the Negaunee formation in the Marquette, Crystal Falls, Iron River, and Florence districts, and at the upper horizon of the Vulcan formation in the Menominee district; (5) by slate layers within the iron-bearing formation, locally developed in the Gogebic, Cuyuna, and Mesabi districts; and (6) by granite, as in the Gwinn district and very locally in the Mesabi district.

### Methods of Estimating

In estimating iron-ore tonnages, whether from drill-hole explorations or from records of mine workings, two methods are employed; (1) average depth and area method, and (2) cross-section method, with application of the "end area" formula. If the orebody is one of the deep trough type, common to the Mesabi Range or in a steeply dipping formation, common to the other Lake Superior iron ranges, the cross-section method is preferable. If the orebody is one of the flat layered type, with a comparatively large horizontal extent and relatively uniform thickness, as in many Mesabi orebodies, the average depth and area method may be used. In fact, probably most of the original total ore estimates of Mesabi orebodies have been made according to this method, particularly if only drill exploratory data were available. However, as both methods are used for estimating Mesabi orebodies, a detailed description of Mesabi estimating practice will serve to illustrate the methods.

### Average Depth and Area Method

The initial exploration of the iron orebodies of the Mesabi Range is done with churn and diamond drills, which are familiar to most mining men. Different systems of locating the holes are used by different companies, depending somewhat on the part of the range to be explored and other local conditions. The most common system is to locate holes at intersections of north-south and east-west coördinates, spaced either 200 or 300 ft. apart. Holes intermediate between these are drilled also, if necessary to determine more accurately the outline and structure of the orebody. Experience has proved that the 200-ft. spacing is not too close for most parts of the Mesabi Range.

After the completion of the drilling exploration of a property, the following average depth and area method may be used in making an estimate of tonnage of ore; but it is not the most accurate method and is not recommended except for flat orebodies having a fairly uniform thickness of ore. On a map showing locations of all drill holes, an outline is drawn at an arbitrary distance, with 100 ft. as the maximum, outside of the ore holes that delimit the orebody, and this outline so drawn represents the area of the orebody. Another system used to establish the limiting edge of the orebody is to place the boundary a distance outside of the limiting holes equal to the depth of ore in the holes, and to connect all points so established with straight lines. Another method is to assume ore to extend 100 ft. beyond the limiting holes if the depth of ore in the hole is 50 ft. or more, to extend 50 ft. beyond if the depth is 25 to 50 ft. and to extend 25 ft. beyond if the depth is less than 25 feet.

The three methods described are empirical, to establish uniformity of methods in the estimates of one company, and are probably conservative on the average. The ore area, however determined, is obtained by a planimeter from the map and reduced to square feet. This area, multiplied by the average depth in feet of ore in the area disclosed by exploration work, gives the volume of ore in cubic feet, which is converted to tons by dividing by a suitable factor (discussed later). If the drill-holes are spaced irregularly, as in much early drilling on the Mesabi Range, it is advisable to group certain holes in computing average depths.

### Cross-section Method

The cross-section method is much more accurate than the methods described and is preferable for determining the area and estimating the tonnage of an orebody. Four main and several minor structural subdivisions can be recognized in Mesabi Range orebodies. In drill explorations, all drill holes, both in rock and ore, should be classified closely into these known structural subdivisions and such classifications should be correlated on cross-sections. This work can be done only by engineers expert in such classification. Such structural layers will give indications of proximity of the rock walls which enclose the orebodies. Drill-holes intermediate between the holes spaced 200 or 300 ft. apart can be drilled where required to determine more accurately the locations of rock walls enclosing the orebody. Especially in the case of the trough-type orebodies, which is the most common type on the Mesabi, the limiting rock walls continue for long distances in fairly straight lines and can be traced between drill holes with a considerable degree of accuracy by proper location of intermediate drill holes, following close structural study of the original holes spaced on intersections of coördinates as described above.

The limits of the orebody can be transferred from the drill-hole map to the vertical cross-sections, after they have been finally established and estimates of volume

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can be made from the cross-sections. The volumes are converted to tons by use of a suitable factor. The interval between cross-sections is usually 100 ft. In irregular orebodies shorter intervals may be desirable. Such estimates should be made by separate structural layers because of the regular shape which the drill holes often show the orebody (especially its bottom) to have. The average analysis or quality of the ore is computed on each cross-section for each structural layer separately by the foot-unit method described below. Then the average analyses of similar ores represented on each cross-section are combined in proportion to their tonnage.

A variation of the cross-section method, with horizontal sections instead of vertical sections, is often used in estimating ore in a developed mine, particularly if mining is well advanced and the orebody is considerably cut up by mined areas and pillars. The horizontal sections used are the plan maps of the mine levels and sub-levels.

### Empirical Rules

The methods described are used in the various fields with certain variations which may be indicated by the following empirical rules adopted to guide the engineer in his interpretation of geological data:

1. In the Mesabi district, the edge of the orebody is placed at a distance which is a function of the depth of ore in the drill hole, or at an arbitrary distance with 100 ft. as the maximum. Data should be available at 300-ft. intervals to establish the continuity of the orebody. However, if the structure of the orebody is known, the continuity of the ore in its horizontal extent may be considered to be established for a much greater distance than 300 ft. between proved points in the ore deposit along the trend of the major axis of the orebody—*i.e.*, trend of system of fractures which directed course of concentration—while, at right angles to this trend, the 300-ft. interval is often too great.

2. In the Cuyuna district, ore is usually estimated from the surface material down the dip to a horizontal plane at the greatest depth of ore encountered on each cross-section, although some operators assume the ore to continue 50 ft. below the deepest ore cut by drill holes. At right angles to the bedding, very little leeway (less than 25 ft.) is allowed in estimating the ore in a stratum not actually cut by a drill hole or development workings. Ore is considered to be proved between cross sections at 300 to 400-ft. intervals along the strike.

3. In the Marquette district, estimates are made by the vertical cross-section method or level plan method.

If the structure controlling the localization of the ore is determined by the drilling or development work, the ore at the ends of the cross-sections is limited by it. If the structure is not indicated, the ore is limited on the ends of each cross-section by a triangle, the altitude of which is one third the thickness of the ore at its proved edge.

The ore is assumed to continue along the strike, or line at right angles to the plane of the cross-section, beyond the end sections for a distance of 50 ft. with the same areas it has on the end sections.

When using the plan method the ore is limited above and below the extreme horizontal sections by apexing, pinching out, or extending with a full area a variable distance, depending on the size of that area and on local conditions. Usually this distance is from 25 to 50 ft.

4. In the Vermilion district a considerable amount of drilling exploration has been done during the past 40 years, but this amount is relatively small compared with the drilling done in other Lake Superior iron districts. No large iron-ore deposit has been discovered by initial drilling and the Vermilion Range is known as the most difficult and expensive area in which to drill in the Lake Superior district. Consequently, no practice for estimating ore discovered by drill holes has been established for the Vermilion Range.

The iron formation or jasper is found in pitching synclines and anticlines, or in steeply dipping lenses, having greenstone foot wall and in many places apparently overlaid by greenstone also. Both jasper and greenstone are intruded most irregularly and intricately by basic igneous rocks, chiefly porphyries. Beside the two large orebodies at Soudan and Ely, only four or five small and (to date) unimportant orebodies have been discovered on the Vermilion. During the past year, considerable geologic knowledge has been added to that previously assembled regarding Vermilion orebodies, particularly in recognizing great quantities of intrusives in both Ely and Soudan mine areas and in interpreting accurately the structure of these orebodies. This additional information is of much importance in estimating ore tonnages.

Ore estimates are made from mine workings. Such ore as is practically blocked out underground is estimated as developed ore, either by cross-section method or by averaging the ore areas of the levels and multiplying by distance between. Probable ore is estimated also below bottom levels and as extensions laterally from the main body of developed ore where geologic conditions indicate the probable presence of additional ore. No fixed practice is followed in estimating such probable ore except that 100 ft. vertically below a bottom level is the maximum depth to which ore is assumed to extend. This limit is warranted because of the presence of large quantities of igneous intrusive rocks in both Ely and Soudan orebodies and the uncertainty as to where the orebodies may be cut off entirely in depth by these intrusives.

The Soudan ore is very hard, dense and high grade and 10 cu. ft. per long ton is used in estimating it. Some of the Ely ore along the foot wall is hard and dense but much of the orebody is relatively soft and some is even granular and fine; 12 cu. ft per long ton is used for it. The Ely orebody lies in a syncline, of which one limb extends eastward between greenstone foot and

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hanging walls. The orebody in the synclinal area occurs at the base of the jasper on the greenstone foot wall. At one place practically the entire width of the syncline is ore. The bottom part of the eastward extension of this jasper syncline is ore, having greenstone on either side of it. Ore is developed in the Ely trough to a vertical depth of 1460 feet.

The Soudan mine is in a combined anticlinal and synclinal area cut by many intrusives so as to form pitching troughs in the jasper. The ore has been localized by leaching and concentration of the jasper in these troughs, one of which has been followed to a vertical depth of 1436 ft. and the other to 1586 feet.

### Classification of Ores

In drill explorations and mining work, most companies analyze ore samples for iron, phosphorus, silica and manganese and some analyze for alumina also.

In all estimates, whether made from drill-hole explorations or from mine workings, classifications of ore are made for commercial purposes, based on chemical and physical character of ore, and estimates are made of the tonnage of each class of ore. The most common classifications of Lake Superior iron ores are:

1. Standard ores (most of which are of merchantable grade and can be shipped direct to docks).
2. Washable ores (occurring principally on Mesabi and Cuyuna Ranges).
3. Lean, non-washable ores.
4. Manganiferous iron ores.

All ores analyzing above 49 or 50 per cent. dry iron are classified as Standard Ores. Some companies use one limit, some the other. Standard ores are subdivided into Bessemer and Non-Bessemer. A Bessemer ore is one that can be used with suitable fluxes to make a Bessemer pig iron. According to the current furnace practice on Mesabi Range ores, those that contain 0.00075 to 0.00085 per cent. or less of phosphorus for each one per cent. of iron are classified as Bessemer in ore reserve estimates. The particular ratio to be used depends on the phosphorus content of the limestone and coke used in the furnace. Actual Bessemer ore shipments are graded closer to the higher ratio than to the lower. All Standard Ores not Bessemer are classified as Non-Bessemer. Washable ores are those in which fine free sand is interbedded with lenses and layers of clean ore. Washable ore classifications are made from an examination of samples, the texture and structure governing more than the iron analysis. All churn-drilled material of non-washable character analyzing less than 49 to 50 per cent. dry iron and over 35 or 40 per cent. are called lean, non-washable ores. Different companies use different limits. It is the general practice to classify all the diamond-drilled material analyzing less than 49 or 50 per cent. dry iron as taconite, or jasper, the local names for the iron-formation rock.

Manganiferous iron ores have been shipped from the Lake Superior district for several years past and in large quantities particularly from the Cuyuna Range since 1915. The range of manganese content of such ores has been from 3.50 to 30 per cent. and the iron content from 35 per cent. up, the minimum combined metals of such ores shipped analyzing about 53 per cent. dried at 212° F.

In addition to the above classifications, ores from producing or prospective producing mines are classified into grades having definite trade names and guarantees under which they are shipped and sold.

The quality of ore of each class or grade in an orebody is computed by the foot-unit method. That is, each assay is multiplied by the footage it represents and the summation of the like units is divided by the total footage of samples. In drill explorations, samples are taken usually of each 5 ft. of material drilled.

This method of computing average quality of ore can be applied to estimates made from records of mine workings, using drift, raise, winze and shaft records instead of drill-hole records, taking care to use in proper proportion the different records. For example, on the Mesabi, on account of its comparative flatness, a 25-ft. drift sample may be given equal weight in the calculations with a 5-ft. raise or drill-hole sample.

### Cubic Feet per Ton Factor

The density of the ore varies considerably in different layers of any orebody and even in different parts of the same layer, depending on iron content, porosity and hydration. The relation between iron content and density is fairly definite, but many wide variations from a fixed relation occur. Wherever possible, density tests should be made in a great many different parts and different structural layers of an orebody by weighing the amount of ore excavated very carefully from a given volume. A steel frame, 2 or 3-ft. cube, can be used very conveniently for this purpose, driving it down into the ore and excavating the material enclosed as it is driven.

More than 20 years ago the results of a great many such tests on Mesabi Range ores were tabulated and platted with relation to the iron content of the ore and an average curve was drawn showing such relation. This curve still is in wide use by mining companies and the Minnesota State Tax Commission, especially for determining density of ore in bodies explored by drilling but not opened up.

The factor of cubic feet per long ton of ore in place in an orebody for Mesabi ore varies from 10.5 to 18 cu. ft., the average being approximately 13.5 for the direct shipping ore. The washable ore of the western Mesabi averages about 14 cu. ft. per long ton. An average of 20 cu. ft. may be used to represent the volume of crude ore that will make one ton of concentrates. This figure is based on the fact that in the Coleraine district of the western Mesabi, an average of 20.6 cu. ft. has been excavated per ton of ore shipped, including both

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concentrates and direct shipping ore. This figure includes all lean ore taken from open pits and stockpiled and is representative of several million tons of ore mined.

Where the ore formation is adaptable, the factor of cubic feet of ore per long ton can be determined by means of moisture of saturation method as described by W. J. Mead in U. S. Geol. Survey *Monograph* 52, page 480. This method is not generally used in the iron-ore districts, principally because the ease with which it can be applied is not understood. According to Mead, "The cubic contents of an ore is a direct function of (a) true specific gravity of the material—that is, the specific gravity unaffected by porosity or moisture; (b) porosity of the material, in terms of percentage of volume occupied by pore space or voids; (c) percentage of moisture in the material—that is, the percentage loss in weight on drying at 110° C."

By saturating the ore in place, a means is found to calculate the porosity of the ore. The specific gravity may be computed from the analyses and the moisture in the ore taken from the average of shipments or determined from a sample of the ore taken before saturation. Niches are cut in the bank or along the sides of a drift, so that an undisturbed projection of ore is left; water is poured into the niches and the knob or projection of undisturbed ore becomes saturated after a sufficient interval of time has elapsed. Samples are then taken of the ore *saturated in place.* Composite samples from a series of these niches are usually taken. These samples are analyzed, in case of iron ore, for iron, silica, alumina, moisture, and loss by ignition. Analysis of one sample is given below; the alumina content was so small that it was considered negligible for purposes of calculation:

Iron, 59.14 per cent. Loss by ignition, 8.03 per cent.
$SiO_2$, 3.97 per cent.

Moisture in natural state, 11.0 per cent.
Moisture after saturation, 14.9 per cent.

The mineral density or true specific gravity of the material is obtained by actual determinations by gravity methods, or is calculated by properly combining the specific gravity of constituent minerals. To carry out the latter method it is first necessary to determine the mineral composition of the ore from its chemical analysis. In this case, the loss by ignition (8.03 per cent.) is considered to represent the water of crystallization of limonite, which is known to be one of the main constituents of the ore. Pure limonite contains 14.5 per cent. water, hence the ore is in part $\frac{8.03}{14.5}$ (or 55.4 per cent.) limonite and the mineral constituents of the ore for our purpose are taken to be 55.4 per cent. limonite, 4.0 per cent. silica, 40.6 per cent. hematite.

The specific gravities of the principal minerals of iron ore are as follows: hematite, 4.5 for earthy ores, 5.1 for crystalline and hard ores; limonite, 3.6; kaolin, 2.62; quartz, 2.65.

As specific gravity is a function of volume as well as weight, the mineral specific gravity is obtained as follows:

55.4 per cent. by weight has a volume equal to $\frac{1}{3.6}$ of an equal weight of water.

4.0 per cent. by weight has a volume equal to $\frac{1}{2.65}$ of an equal weight of water.

40.6 per cent. by weight has a volume equal to $\frac{1}{4.5}$ of an equal weight of water.

Reducing to unit volumes:

$$\frac{55.4}{3.6} = 15.4 \text{ unit volumes}$$
$$\frac{4}{2.65} = 1.5 \text{ unit volumes}$$
$$\frac{40.6}{4.5} = \underline{9.0 \text{ unit volumes}}$$
$$25.9 \text{ unit volumes}$$

$\frac{100}{25.9} = 3.86$ mineral specific gravity. From analyses, 14.9 per cent. = moisture of saturation (amount of water by weight necessary to fill all voids).

Hence, 14.9 per cent. water (S. G. 1) occupies 14.9 unit volumes
85.1 per cent. with S. G. 3.86, occupies $\frac{85.1}{3.86} = \frac{22.0}{36.9}$ unit volumes.

$$\frac{14.9}{36.9} = 40 \text{ per cent. of porosity.}$$

By use of the diagram in *Monograph* 52 (also published in Lefax form) an ore with mineral specific gravity of 3.86, 40 per cent. porosity, and 11.0 per cent. moisture, is found to occupy in place 13.7 cu. ft. to the ton (2240 lb.).

### Mining Loss

In estimates made from exploratory data, no deductions are made for rock and mining loss, as past experience has shown that the minor extensions of the orebody, which can not be determined in normal explorations, will offset such losses. In estimating orebodies completely developed, this deduction varies with the mining methods employed and factors of a purely local nature.

## Methods of Estimating Ore on the Gogebic Range*

By J. F. Wolff,† Duluth, Minn.

THE iron formation of the Gogebic Range in northeastern Wisconsin and northwestern upper peninsula of Michigan resembles that of the Mesabi Range in Minnesota very closely in lithologic character and the subdivisions and horizons which can be recognized in it. It contains numerous interbedded slaty layers and considerable intraformational conglomerate in certain horizons.

In contrast to the flat dip of the Mesabi formation, the Gogebic dips steeply to the northwest at an average angle of about 70°. It has a quartzite and siliceous slate foot wall and a hanging wall of conglomerate, gray-wacke and slate. It has been intruded most intricately by basic dikes and sills.

*Read at February meeting of A. I. M. E., but not published in pamphlet form.

†Mining Engineer, Oliver Iron Mining Co.

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The troughs formed by intersection of foot wall or interbedded slaty horizons and the dikes, or by intersections of dikes themselves or dikes and sills, are V-shaped. In length, they vary from a few hundred to several thousand feet and in width and height from several feet to a few hundred feet. Several orebodies may occur one above the other in successive higher horizons of the iron formation on the same dike. Different dikes intersect the iron formation at varying depths, so that any one 40-acre tract may contain several orebodies, on different dikes at different vertical depths. Ore is known to exist at a depth of approximately 3000 ft. below the surface. The top part of the cross-sectional area of any part of an orebody usually is quite irregular in outline. The greatest vertical height of the cross-section usually occurs along the foot wall of the orebody. The tonnage in individual orebodies varies from a hundred thousand to tens of millions.

Methods of estimating used on the Gogebic Range depend on the exploration method by which the ore has been proved. If the ore to be estimated has been developed by underground workings, some engineers estimate the volume included between different levels by multiplying average areas of adjoining levels by the average distance between levels. The depth to which ore is assumed to continue down a dike below the bottom level depends much on the size, shape and quality of the orebody, but it is rarely estimated more than 100 ft. below the bottom level.

If underground work is extensive enough to allow preparation of cross-sections every 50 ft. along the strike, estimates are made by cross-sections rather than by areas of levels multiplied by average depth between them. Many of the largest mines on the Range are estimated by the cross-section method. Deductions are made for mine workings, whichever method is used. If the orebody is a uniform and large one and there is no diminution of area on the end cross-sections, or other limiting conditions, it is common practice to assume the ore to continue 100 ft. beyond the end areas that have actually been developed. If the orebody is large and regular, the ore is assumed to extend not more than 100 ft. below the bottom level unless the underlying dike lies within such limit; in this case the orebody would be figured as extending downward from the bottom level to the dike. If the orebody lies in pockets rather than in a large regular body, it is rarely assumed to extend more than 35 ft., or two working sublevels, below the bottom developed level.

Except in the area of the Plymouth-Wakefield orebody, west of Sunday Lake, Gogebic Range orebodies have not been explored or discovered by diamond drilling. Drills have been used principally to locate position of dikes, foot wall, etc., rather than to discover and block out orebodies. The shape, regularity and continuity of Gogebic Range orebodies varies a great deal in the different horizons.

Factors of 10 cu. ft. per long ton, for ore averaging over 60 per cent. dry iron and 11 cu. ft. for ore below 57 per cent. dry iron, are used in reducing volumes to tons; 10 per cent. reduction usually is allowed for mining loss and 10 per cent. for rock encountered in the ore.

Average analyses for specific tonnages are computed by the foot-unit method and tonnage by the ton-unit method.

## Politicians and Labor Leaders

THE attitude of the politicians toward the militant labor leaders was thus paraphrased by the *Wall Street Journal*: Says the policeman, a public servant, to the enterprising burglar and his victim: "This is a time for moderation and compromise. You may, therefore, fight it out temporarily, but if the householder fails to make a better citizen of the burglar I will ask the chief of police to take possession of the victim's house. We will then invite the burglar to operate it—under Government regulation, of course—and any deficit in operation will be made up by taxes collected from the householder."

## Benefit of Strikes

THE president of the Baldwin Locomotive Works, Samuel M.Vauclain, in a recent interview, offered the following unique views: "In the long run the coal strike will be of immeasurable benefit to the country. Business is finding ways of getting along without so much coal. In the past we burned too much coal because we could always get it, but when this strike is over the country will not burn over two-thirds of what it did before. People are more economical in the use of coal and are studying ways and appliances to reduce consumption; also they are looking into substitutes for coal.

"The same thing is true of the railroad strike. It will prove to be a vast benefit for the railroads as they have learned how many men they can do without. One foreman told me the strike was a blessing as he found out for himself how many men were actually needed to handle the work. Two-thirds of the men now on strike will never get back, as they won't be needed."

## A Skin Game?

THE other day a Wall Street man started a conversation with a union organizer by remarking: "Sending Brindell to prison must have surprised union men considerably."

The union leader replied: "Brindell deserved it. It's a good thing to have the likes of him in jail."

"Yes, it surely is bad for unionism to have such a prominent leader proved to have been a grafter," continued the Wall Street man.

"That gorilla deserved to be caged," the union organizer blurted out with warmth. "The dirty skunk played it solitaire."—*The Wall Street Journal.*

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# San Francisco Meeting

THE committee in charge of arrangements for the meeting of the Institute in September has completed its program. The headquarters of the meeting will be at the Palace Hotel, San Francisco, and the registration committee will be at the hotel all day on Sunday, Sept. 24, and from 8 a.m. until noon on Monday.

On Sunday afternoon, automobiles will be available for sightseeing trips around the city.

Monday will be devoted to technical sessions. In the morning, there will be sessions on Mining and on Iron and Steel; in the afternoon, sessions on Mining and Milling. At these sessions, in addition to the papers mentioned in the tentative list printed in August, there will be presented three papers on the geology, mining and milling of the Comstock lode; one on the Aztec mine, Baldy, N. M.; one on the Colombian oil fields; and one on charcoal precipitation of cyanide solutions. The luncheon on that day will be Dutch Treat, for men only, at the Engineers Club.

On Monday evening, there will be an informal buffet supper at the home of F. W. Bradley.

On Tuesday morning, a party of 50 men will leave for Hetch Hetchy. During the four days of the trip, the party will see the Priest tunnel and earth dam under construction by steam-shovel and hydraulic-fill methods, the Big Creek shaft and tunnel, early intake power plant and tunnels and the Hetch Hetchy dam under construction.

For those who remain in San Francisco, Tuesday will be "San Francisco Day." There will be motor trips to the Presidio, Cliff House, Golden Gate Park, and other points of interest, and shopping trips to Chinatown.

On Wednesday, "University of California Day," the party will be guided through the university by members of the Mining Association, the affiliated student society, and will see the Greak Theatre and notable buildings.

Thursday will be "Leland Standford, Jr. University Day." Automobiles will leave the Palace Hotel at 10 a.m., and will return from the university at 4.30 p.m.

Friday has been reserved for trips to the Selby Smelter, to Mt. Tamalpais, or to other points of interest.

Arrangements will be made to visit the mines or gold dredges in California, if members desire to do so, but such trips must of necessity be considered special trips and arrangements will have to be made to suit the convenience of the individual or party. The Golf Committee will make arrangements for those who wish to play golf.

Those who wish to visit Yosemite Valley, the Big Trees or any of the other many attractions in California, should at once advise the Secretary of the San Francisco Section, C. H. Fry, 625 Market St., who will arrange for such trips. Arrangements for all entertainments scheduled will be made according to the number that will attend. Please notify Mr. Fry as to which entertainments you wish to attend, and tell him the number of persons that will be in your party.

*Underwood & Underwood*

CHINESE TELEPHONE EXCHANGE IN SAN FRANCISCO.

The members of the General Arrangements Committee are F. W. Bradley, chairman; Fletcher Hamilton; C. W. Merrill; F. H. Probert; T. A. Rickard. Chairmen of special entertainment committees are:

Automobiles.—Abbot A. Hanks.

Dredges.—Edwin Higgins. Golf.—T. A. Rickard.

Hetch Hetchy Trip.—M. M. O'Shaughnessy.

Hotels.—Roy N. Bishop. Mines.—W. J. Loring.

Registration.—F. L. Sizer.

Stanford University.—T. J. Hoover.

University of California.—Frank A. Probert.

Woman's Auxiliary.—Mrs. F. W. Bradley, chairman; Mrs. Oliver C. Ralston, secretary.

Ladies are invited to all entertainments that have not been limited to men. The San Francisco Section of the Woman's Auxiliary will arrange for other entertainments.

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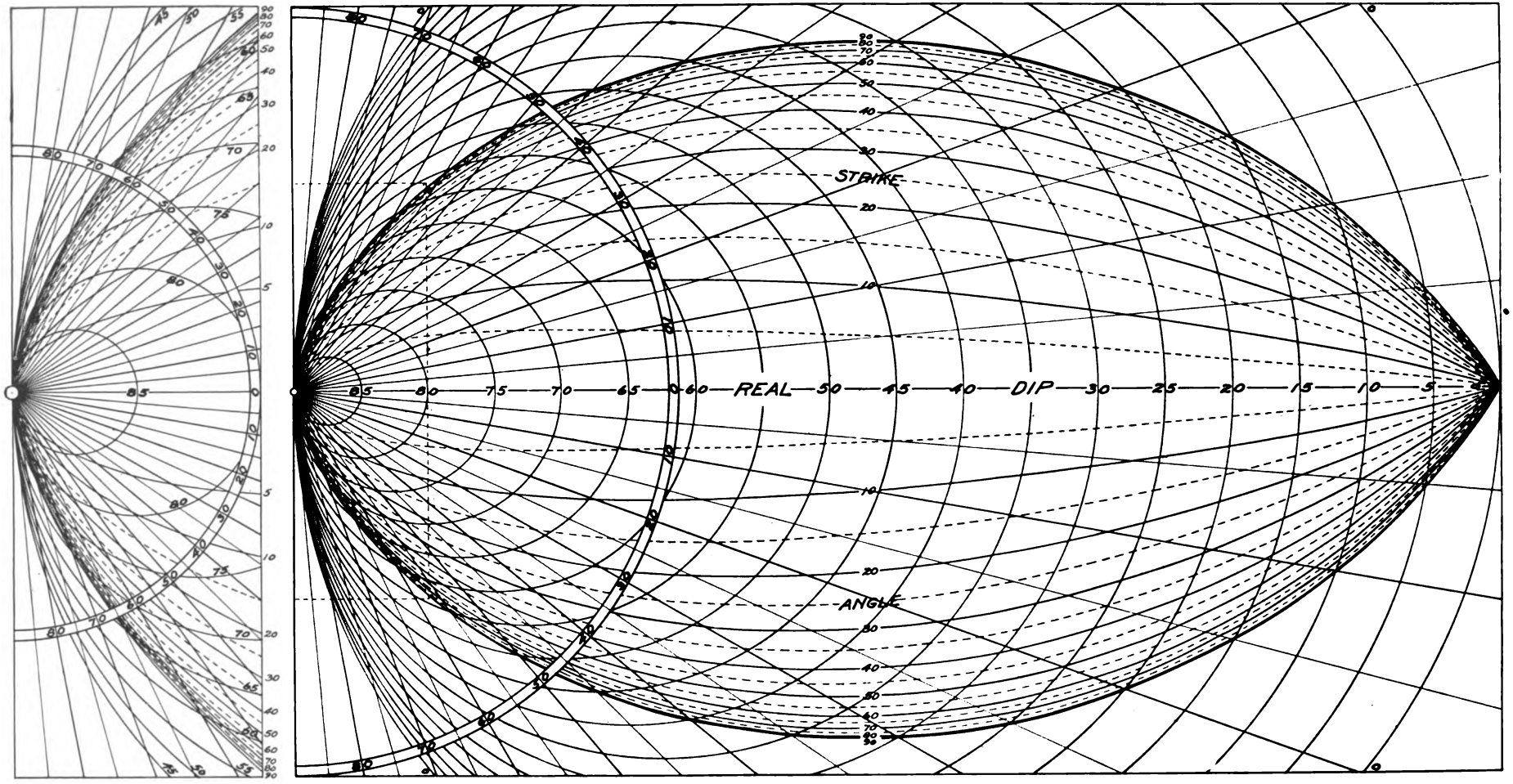


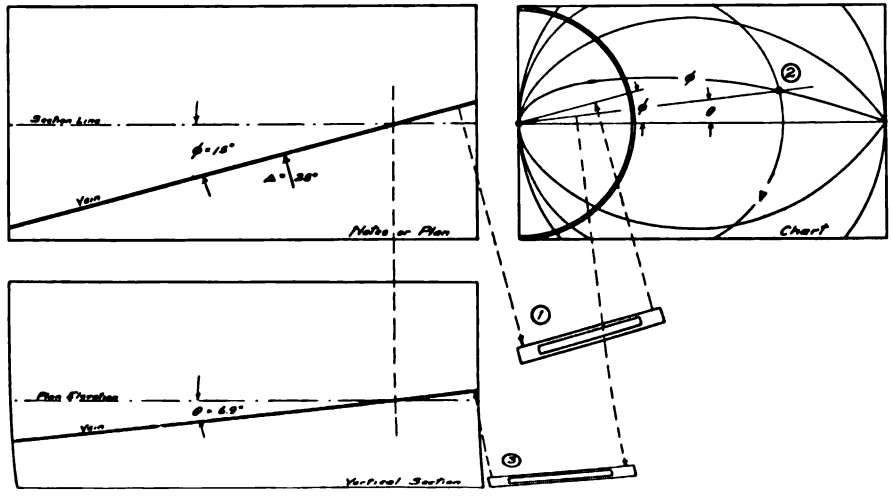


## Gaby Geological Dip Chart

ORIENT notes or plan, vertical section to be made, and chart, as in diagram, and in any convenient relative positions.

1. With parallel ruler carry strike of structure into protractor and note strike angle ($\phi$). Also note real dip of structure ($\Delta$).

2. Using coördinates of chart, pick point of intersection of $\phi$ and $\Delta$, entering chart on upper or lower side to correspond with predetermined approximate position of apparent dip or trace of structure on section.

3. Place edge of ruler on line from this point to center of protractor, giving angle of apparent dip ($\theta$), and roll line into section.

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# A Slide-rule Dip Chart

By W. E. GABY

Engineer and Mining Geologist, Salt Lake City, Utah

THE form of dip chart here presented for the use of the profession was devised by the author when he was confronted with a particularly heavy job of geological section making and did not have any of the usual tables or charts at hand. This was at the property of the Teziutlan Copper Co. in Puebla, Mexico, where the orebodies are much faulted and lie conformably with a slightly inclined and much folded schist. Because of the low dip and the folding of the orebodies, the engineering and geological data respecting them were best represented on vertical cross-sections quite closely spaced.

When I approached the problem of constructing a dip chart, it was with this idea of eliminating all possible mechanical labor. In the form discovered, two sets of curved lines, each tangent to the 90° line at the center of the protractor, constitute a system of coördinates by means of which one may pick a point on the protractor that will determine the angle of apparent dip, of a vein or other geological structure, upon the vertical section. A line from this point to the center of the protractor establishes the angle. In finding the point, it is usually best to follow the coördinate of the strike angle to its intersection with the coördinate of the real dip angle. The apparent dip angle sought, of course, may face to the left or the right. If to the left, as happens in the diagram (vertical section), the eliminate the tedious manipulations of a separate protractor. In fact, using the parallel ruler as described, it is not even necessary to make note of the angle sought. It is brought out graphically, leaving the mind free to note the correlations. The chart itself may be made more convenient by reproduction on celluloid with a slot running on the zero line of the protractor.

*Calculated Table of Apparent Dips in Vertical Section, Gaby Geological Dip Chart*

| Strike angle | Real Dip | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 85° | 80° | 75° | 70° | 65° | 60° | 55° | 50° | 45° | 40° | 35° | 30 | 25° | 20° | 15° | 10° | 5° |
| | Apparent Dip | | | | | | | | | | | | | | | | |
| 85 | 84.9 | 79.9 | 74.9 | 69.9 | 64.9 | 59.9 | 54.9 | 49.9 | 44.9 | 39.9 | 34.9 | 29.9 | 24.9 | 19.9 | 14.9 | 10.0 | 5.0 |
| 80 | 84.8 | 79.8 | 74.8 | 69.7 | 64.7 | 59.6 | 54.6 | 49.6 | 44.6 | 39.6 | 34.6 | 29.6 | 24.7 | 19.7 | 14.8 | 9.9 | 4.9 |
| 75 | 84.7 | 79.6 | 74.5 | 69.4 | 64.3 | 59.1 | 54.1 | 49.0 | 44.0 | 39.0 | 34.1 | 29.7 | 24.2 | 19.4 | 14.5 | 9.7 | 4.8 |
| 70 | 84.6 | 79.4 | 74.1 | 68.8 | 63.6 | 58.4 | 53.3 | 48.2 | 43.2 | 38.3 | 33.3 | 28.5 | 23.7 | 18.9 | 14.1 | 9.4 | 4.7 |
| 65 | 84.5 | 79.0 | 73.4 | 68.2 | 63.0 | 57.5 | 52.3 | 47.2 | 42.2 | 37.3 | 32.4 | 27.6 | 22.9 | 18.3 | 13.5 | 9.1 | 4.5 |
| 60 | 84.2 | 78.5 | 72.8 | 67.2 | 61.7 | 56.3 | 51.1 | 45.9 | 40.9 | 36.0 | 31.6 | 26.6 | 22.0 | 17.5 | 13.1 | 8.7 | 4.3 |
| 55 | 83.9 | 77.8 | 71.9 | 66.1 | 60.3 | 54.8 | 49.5 | 44.3 | 39.3 | 34.5 | 29.8 | 25.3 | 20.9 | 16.6 | 12.4 | 8.2 | 4.1 |
| 50 | 83.5 | 77.1 | 70.7 | 64.6 | 58.7 | 53.0 | 47.6 | 42.4 | 37.5 | 32.7 | 28.2 | 23.9 | 19.7 | 15.6 | 11.6 | 7.7 | 3.8 |
| 45 | 82.9 | 76.0 | 69.2 | 62.8 | 56.6 | 50.8 | 45.3 | 40.1 | 35.3 | 30.7 | 26.3 | 22.2 | 18.3 | 14.4 | 10.7 | 7.1 | 3.5 |
| 40 | 82.2 | 74.7 | 67.4 | 60.5 | 54.0 | 48.1 | 42.6 | 37.5 | 32.7 | 28.3 | 24.2 | 20.4 | 16.7 | 13.2 | 9.8 | 6.5 | 3.2 |
| 35 | 81.3 | 72.9 | 64.9 | 57.6 | 50.9 | 44.8 | 39.3 | 34.4 | 29.8 | 25.7 | 21.9 | 18.3 | 15.0 | 11.8 | 8.8 | 5.8 | 2.9 |
| 30 | 80.1 | 70.6 | 61.8 | 54.0 | 47.0 | 40.9 | 35.2 | 30.8 | 26.6 | 22.8 | 19.3 | 16.1 | 13.1 | 10.3 | 7.6 | 5.0 | 2.5 |
| 25 | 78.3 | 67.4 | 57.6 | 49.3 | 42.2 | 36.2 | 31.2 | 26.7 | 22.9 | 19.5 | 16.5 | 13.7 | 11.1 | 8.7 | 6.5 | 4.3 | 2.1 |
| 20 | 75.6 | 62.7 | 51.9 | 43.2 | 36.3 | 30.6 | 26.0 | 22.2 | 18.9 | 16.0 | 13.5 | 11.2 | 9.1 | 7.1 | 5.2 | 3.5 | 1.7 |
| 15 | 71.3 | 55.7 | 44.0 | 35.4 | 29.0 | 24.2 | 20.3 | 17.2 | 14.5 | 12.2 | 10.3 | 8.5 | 6.9 | 5.4 | 4.0 | 2.6 | 1.3 |
| 10 | 63.2 | 44.6 | 32.9 | 25.5 | 20.4 | 16.7 | 13.9 | 11.7 | 9.9 | 8.3 | 6.9 | 5.7 | 4.6 | 3.6 | 2.7 | 1.8 | 0.9 |
| 5 | 45.0 | 26.3 | 18.0 | 13.5 | 10.6 | 8.6 | 7.2 | 5.9 | 5.0 | 4.2 | 3.5 | 2.9 | 2.3 | 1.8 | 1.3 | 0.9 | 0.4 |

A less finished form of the chart was published in the *Mining & Scientific Press* of Aug. 6, 1921, with an explanation of its use. I have checked the new drawing for accuracy against the calculated table given, and constructed an explanatory diagram beneath. As some geologists are accustomed to using the table, I have included it, since no advantage is obtained by mere interpolations from the chart to get the required angle, except as it gives a mental picture of this angle. The chart gives a more rapid and much easier solution when cases multiply so that it becomes desirable to

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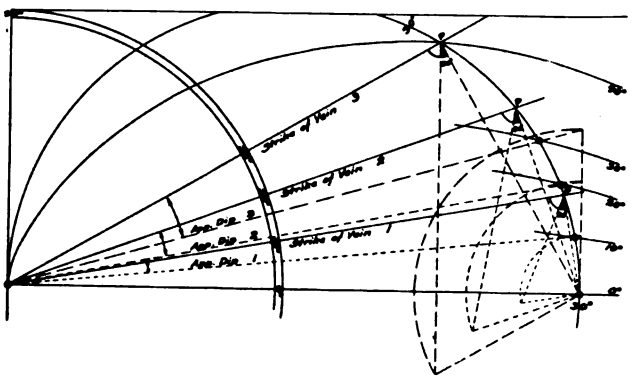
upper side of the chart is used; if to the right, the lower.

The chart is constructed on the center or zero line of a protractor, as representing the line or course of a vertical section. This line is divided into eighteen equal parts, representing from outside to center each



five degrees of real dip. The radiating lines of the protractor then represent every five-degree position of the strike of veins. The illustration given will show the graphical construction, which, carried out for all even cases, gives the series of points that determine the coördinate lines for any odd case. The solution ordinarily employed to find an apparent dip is used here in a series of cases condensed to conform with the conditions of the problem as set forth above. It is also conditional that all the perpendiculars (P) erected on the strikes pass through the line of section at a common point, that representing the particular dip being used. The angle of apparent dip sought for each is then resolved so that it also falls into the protractor. The succession of base points of the strike perpendiculars generates the arc of a circle and forms the coördinate for the dip being used (30 in the illustration). The intersections with this arc of each line representing an apparent dip angle give points at the crossing of the strike-angle coördinates. The latter coördinate lines are then drawn connecting points for an identical strike angle in all the arcs of the dip angles. The chart thus constructed then permits a rapid solution of any combination of strike and dip. To make more clear that portion of the chart adjacent to the center of the protractor, where the lines converge, a portion has been doubled in size.

Most mining geological sections are prepared on transparent material, so that by squaring them over the chart and orienting the notes or plan alongside, all the drafting detail can be executed with pencils and a parallel ruler. The calculated table is a useful supplement, and a job of section making that lends itself to this method will require far less time and labor. Not the least advantage is its freedom from annoying mechanical detail. An outline of the method is given at the bottom of the chart.

## New Life-saving Aid

AS the result of experiments made by the U. S. Bureau of Mines, the geophone, an instrument used during the war for the detection of earth and rock sounds in the construction of military mines and tunnels, promises to become an active factor in the saving of the lives of miners entombed as the result of fires and explosions. Blows with a sledge on a coal face were heard by the Bureau's investigators, by means of the geophone, at a distance of 650 ft., with various rooms and entries intervening. On a suspended pipe line, light hammering with the knuckles was detected at a distance of 1500 ft. Ordinary talking and singing could be detected through 150 ft. of solid coal. By the use of two geophones, one instrument to each ear, it is possible to determine the direction from which a sound is coming through the earth, and thus to locate the approximate position of the entombed miner. The Bureau gives recommendations for a signal code to establish communication between the rescuing party and those entombed.

By means of the instrument, it is possible to hear water circulating in the pipes of ordinary city mains situated 10 to 15 ft. below the surface. Tests conducted at a busy corner in the downtown district of Pittsburgh located a leak in a water main which the water company had for two weeks vainly sought to detect.

The mine geophone is sensitive, yet extremely simple and easily portable. The instrument was invented by the French during the war. It was developed by the United States Engineers, and the instruments now used by the Bureau of Mines were made according to plans drawn by them, except for the introduction of different diaphragms. The geophone is essentially a small seismograph, as it embodies the same principles as the ponderous apparatus that records earthquake tremors. It consists of a lead weight suspended between two elastic diaphragms cutting across a small airtight box. If the instrument is placed on the ground and anyone is pounding or digging in the vicinity, energy is transmitted as wave motion to the earth, and the earth waves shake the geophone case. The geophone, therefore, transforms the earth wave into an air wave, which is heard by the ear as sound, and at the same time magnifies the wave so that the sound is louder than if the ears were placed in direct contact with the earth.

The observations of the Bureau of Mines indicate that the geophone may be useful in the location of mine fires. Usually a mine fire makes enough noise, either by drawing air or by breaking off slate and coal, to be heard for a considerable distance through the coal and even through the strata above. The distance that these sounds can be heard depends a great deal on the nature of the strata above the mine, yet the sounds originating at a mine fire should be detected through 100 to 300 ft. of cover and through 500 to 800 ft. of coal. Other uses are given in *Technical Paper* 277.

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# Personal Notes and Biographies

**J. V. Howell** is in the geological department of the Marland Refining Co., Ponca City, Okla.

**Lindley M. Reith** was recently appointed superintendent of the Pacific Lime and Plaster Co., Sonora, Cal.

**R. W. H. Atcherson** is assistant superintendent of open hearths for the Illinois Steel Co., at Gary, Ind.

**German D. Zevallos** has assumed charge of the petrographic collection of the Society of Engineers of Peru, at Lima.

**Frank A. Dalburg,** recently with the West India Oil Co. at Caracas, Venezuela, is now with the Standard Oil Co. of Venezuela, at Maracaibo.

**A. G. Zimmermann,** Lieutenant Commander, has been transferred from the U. S. S. "Nevada" to the U. S. Naval Gun Factory, Washington, D.C.

**E. A. Holbrook,** assistant director of the U. S. Bureau of Mines, has accepted appointment as dean of the School of Mines of Pennsylvania State College.

**S. Merenbach** has been appointed gas inspector for the Pacific Oil Co. and has charge of the gas operations of the company in the Midway, Sunset and Elk Hills fields.

**Alfred Pearson, Jr.** has been appointed general manager of the Kemorovo coal mines, Siberia, Russia, but his address for mail will be Room 301, 110 W. 40th St., New York City.

**N. S. Greensfelder** lectured on the use of explosives in coal mining, to the students attending summer school at Carnegie Institute of Technology and the State College of Pennsylvania.

**H. A. Megraw,** author of several books on cyaniding and flotation, has severed his connection with the Kennedy-Van Saun Mfg. Co. and has become vice-president and secretary of the Crown Oil and Wax Co., in Baltimore.

**Leonard Peckitt,** president of the Empire Steel & Iron Co., of Catasauqua, Pa., has been made president of the Replogle Steel Co., which has taken over the Empire Co., and will make his headquarters in the Equitable Building, New York City.

**L. G. Huntley and Sterling Huntley,** formerly with Johnson, Huntley and Somers, have opened an office, under the firm name of Huntley and Huntley, for consulting work in petroleum engineering and geology, in the Frick Building, Pittsburgh, Pa.

**J. Nelson Nevius,** of Pasadena, Cal., has accepted appointment as valuation engineer (mining) with the Income Tax Unit, Bureau of Internal Revenue, and has entered upon his duties at Washington. His present address is 1330 Columbia Road.

**Robert J. Thompson,** who has been engaged on the coöperative work between the Vanadium Corpn. of America and the U. S. Bureau of Mines, at Ithaca, N. Y., has joined the staff at the research laboratories of the National Canners Assn., Washington, D. C.

**Percy E. Barbour,** Assistant Secretary of the Institute, who has held a commission as Major of Engineers in the Reserve since his discharge from active army service in 1919, has been promoted to Lieutenant-Colonel of Engineers and will be assigned to the 342nd Engineers in the 2nd Corps Area.

**E. W. McCullough** has resigned as director of the Division of Mining and Metallurgy, Republic Creosoting Co., to accept an appointment as consulting engineer for refuse disposal with the Indianapolis City Sanitary Commission. This work will involve the design and construction of a plant.

**Colin G. Fink,** consulting electrometallurgist, has been appointed lecturer in electrochemistry at Columbia University, New York, and is in charge of that division of the Department of Chemical Engineering at the University. He continues as secretary of the American Electrochemical Society, and the Society's office at Lehigh University has been discontinued.

**Charles P. Berkey,** who is with the Third Asiatic Expedition of the American Museum of Natural History in coöperation with the American Asiatic Association and *Asia,* is quoted as follows in the September number of the magazine mentioned, writing from Mongolia early in May: "We have been out a month today and have covered 668 miles of reconnaissance. Now we are camped on the Bokuk Gol about twenty miles southwest of Urga. This is a great camp tonight —our 75 camels came in (caught up) tonight. These with our five motors and twenty-six men and seven tents make quite an imposing group on the Bokuk Gol valley side. It is very cold, and, with these heavy winds, it is trying, but we have managed to work every day either in the field or on the road or on the notes. It was 17° F. this morning and we have had three snowstorms within ten days. I am writing in a tent where I am protected from the wind, but it is necessary to keep

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bundled up as if it were real winter—with leather vests, fur-lined coats and gloves and winter caps. I haven't had my cap off, except the few times I tried to wash my face, either day or night for ten days. We have come north fast and have, at the same time, climbed to an elevation of about 6000 ft; or perhaps we got ahead of the spring season. Fruit-trees were in blossom when we left Peking a month ago. But we are having a mighty good time. This rough life is a great recreation for me and it is agreeing with me in every way. My sleeping-bag is one of the Peary stock that did service on North Pole work; so when I get too cold, I go to bed. It is always comfortable. Our reconnaissance work is progressing very satisfactorily—better, indeed, than we had a right to expect to this point. I take an aneroid reading every mile, and as much oftener as seems to be necessary, and sketch in the geologic structure in cross-section. I now have a geologic section of 636 miles stretching entirely across the Gobi Desert. We have found the country very different from what we were led to expect. Instead of being lost in the sand, we have found ourselves traveling on complex rock structure and across sedimentary basins of just the sort that we hoped to find. We have seldom had to go more than two or three miles in any doubt about our underground conditions. It has been great fun."

## K. F. Hansen

KNUD F. HANSEN died on June 26, at Tampico, Mexico, while carrying on geological work in the southern oil fields.

Mr. Hansen was born in Denmark in 1892. He received the degree of B. S. in Philosophy at the University of Copenhagen, and later studied at the Missouri School of Mines, Rolla, Mo. After leaving college, he was employed at Minas Dolores, Matehuala, S. L. P., Mexico, until March, 1920, when he became a member of the geological department of Cia. Mexicana de Petroleo "El Aguila," S. A.

He was keenly interested in his work, and showed increasing ability to carry on independent geological research.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month July 15 to August 15, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1885 | Sticht, Robert C. | April 30, 1922 |
| 1885 | Emmons, Arthur B | July 12, 1922 |
| 1918 | Hansen, K. F. | June 26, 1922 |
| 1915 | Patterson, John H. | |
| 1902 | Dieffenbach, H. M. | 1921 |
| 1918 | Warfel, C. G. | July 7, 1922 |
| 1882 | Wolf, Albert H | March 13, 1921 |

## Closing Date for Papers

PAPERS for the annual meeting in February must be in the hands of the Secretary before Dec. 1, in order to insure publication and distribution before the meeting, which is the only means of getting the proper amount of discussion of papers and the problems they contain.

It not only contributes to the success of the meeting but helps to reduce the pressure on the Secretary's office, and reduce costs, when papers are received early, so that with sufficient notice it is to the advantage of everybody, including the author, to get these papers in on time.

## Volume LXVII

VOLUME LXVII of the TRANSACTIONS has been shipped to those members of the Institute who indicated a desire for it. Delivery in foreign countries may be slightly delayed as usual on account of shipping arrangements.

Volume LXVII contains papers on Iron and Steel, including those presented at the New York meeting in February of this year, and completes publication of all TRANSACTIONS up to the year 1922. Volume LXVIII, which will be printed in December, for distribution in January, will contain the 1922 papers and discussions (except the iron and steel papers mentioned above), including those of the San Francisco meeting.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Iron and Steel Inst. | London, England | Sept. 5–7 |
| Iron & Steel Elec. Engrs. | Cleveland, Ohio | Sept. 11–15 |
| Natl. Exposition Chem. Industries | New York, N. Y. | Sept. 11–16 |
| Amer. Electrochem. Soc. | Montreal, Que., Can. | Sept. 21–23 |
| **Amer. Inst. of Min. & Met. Engrs** | San Francisco, Cal. | Sept. 25–29 |
| Brazilian Centenary Exhibition | Rio de Janeiro, Brazil | Sept. 7, 1922 to Mch. 31, 1923 |
| Natl. Exposition Power & Mech. Engng | New York, N. Y. | Dec. 7–13 |
| Amer. Soc. for Steel Treating and Amer. Drop Forging Inst., also Internatl. Steel Exposition | Detroit, Mich. | Oct. 2–7 |
| Amer. Mining Congress | Cleveland, Ohio | Oct. 9–14 |
| Soc. Automotive Engrs. | Detroit, Mich. | Oct. 26–27 |

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# Abstracts of Institute Papers

The following papers will be presented at the San Francisco meeting, September, 1922, and will be printed in full in pamphlet form.

A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 20 of the Advertising Section. Discussion of papers is invited.

## Neumann Bands as Evidence of Action of Explosives upon Metal

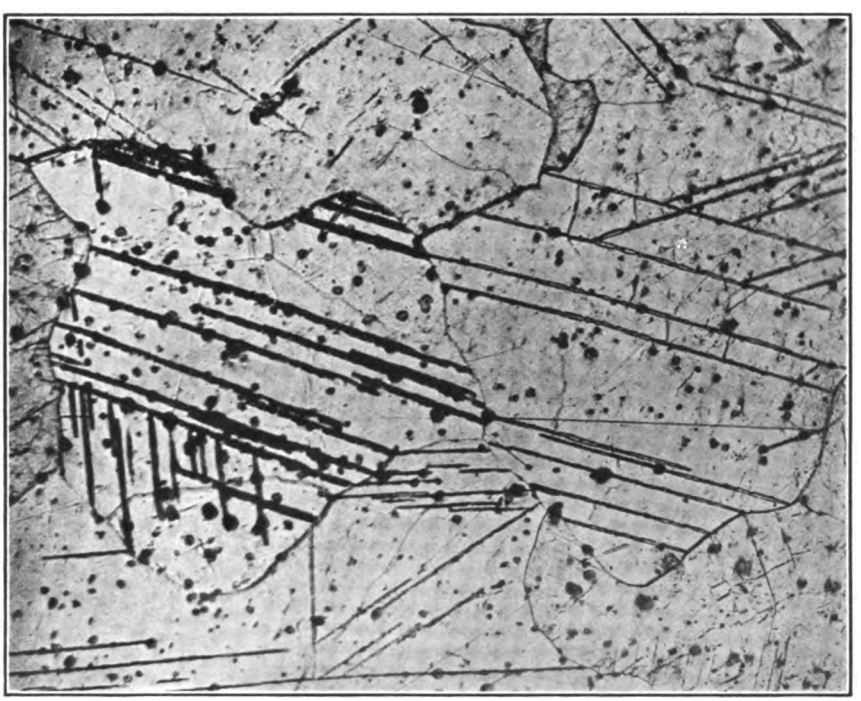
By F. B. Foley, Rolla, Mo., and S. P. Howell, Pittsburgh, Pa.

THIS paper gives description of tests made by a committee of the Division of Engineering of the National Research Council to determine whether velocity of impact affects the formation of Neumann bands.

Not infrequently, in the case of the failure of a metal structure, such as a bridge, tank, airplane, gun carriage, etc., a doubt arises whether the failure was due, among other causes, to the effect of an overburden or of an explosive maliciously or accidentally exploded in contact with it. As few means of discriminating between the effects of these causes have been known and these means were of a rough qualitative character, it was surprising to find, in the record of an inquiry into the failure of a structure, the statement that, by observations on the Neumann bands in the structure, it was possible to determine the speed of breakage in the metal and to distinguish between a fracture caused by an explosion and one caused by an ordinary mechanical strain.

Such a criterion, if well proved, was of value to the explosives experts of the Bureau of Mines, the Ordnance Department of the United States Army and the Bureau of Ordnance of the United States Navy, but search showed no record of it in the literature nor did any of the metallurgists and metallographers consulted know of any data on which such a criterion could be based having been assembled and critically studied. However, it was universally held that there was promise in the idea and that there existed unique facilities at the Bureau of Mines Experiment Station at Pittsburgh for the preparation, under definitely known conditions, of material for study by metallographers, and that material of value might also be obtained from the proving grounds of the Army and Navy. Therefore, with the approval of the Director of the Bureau of Mines and the Chiefs of Ordnance of the War and Navy Departments, the Chairman of the Division of Engineering of the National Research Council, on April 12, 1919, appointed a Committee on the Investigation of Neumann Bands, which has since been engaged in this study and which, after some slight change in its personnel, consists now of the following:

Dr. William Campbell, advisory metallurgist, Bureau of Ordnance, Navy Department; F. B. Foley, metallurgist, Bureau of Mines; S. P. Howell, explosives engineer, Bureau of Mines; Comdr. O. M. Hustvedt, U. S. N., Bureau of Ordnance, Navy Department; Dr. Charles E. Munroe, chief explosives chemist, Bureau of Mines; Dr. Albert Sauveur, professor of metallurgy and metallography, Harvard University; Col. W. H. Tschappat, Technical Staff, Ordnance Department, U. S. A.



Neuman bands in Swedish iron. × 200.

The results of the work, are presented in this paper. The investigators had the benefit of the supervision and advice of Dr. Henry M. Howe. This investigation furnishes evidence in support of the following conclusions:

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1. The abundance of Neumann bands increases with the velocity of impact till this passes 2296 m. per sec. With increase in velocity of impact beyond this point, there is no appreciable increase in abundance.

2. There appears to be a decrease in the number of Neumann bands with the distance from the face of impact to the back of those specimens that were supported by a lead block.

3. Impact velocities up to 5716 m. per sec. do not produce Neumann bands having a number of directions in a single grain greater than four.

4. Neumann bands are found to be both ridges and furrows and their appearance on an etched surface does not seem to result from an etching out of mechanically overstrained metal, which would result in furrows only.

5. In comparing series A with series B, the number of Neumann bands does not bear any apparent relationship to the amount of plastic deformation caused by the impact.

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## Effect of Nickel-chromium on Cast Iron

By Richard Moldenke, Watchung, N. J.

THE paper describes the making of pig iron from the Mayari iron ores of Cuba. The outstanding feature of this pig iron is a considerable content of nickel and chromium. As a marked improvement in the quality of castings has been noted when this iron is used in the foundry mixtures, a series of melting tests of mixtures of great variety of composition was conducted with the idea of getting comparative strengths from which the effect of nickel-chromium could be seen. These tests, on account of their number, and degree of accuracy desired, were made by the crucible melting method. The paper gives the tables of results, a series of curves showing the inter-relation of the elements involved, and a summary of the conclusions derived.

A study of the curves for transverse strength show the following tendencies:

The general tendency of almost all the curves for all percentages of total carbon is downward as the silicon increases.

In general, the iron is weaker as the total carbon increases.

In general, the lower the phosphorus, the stronger the iron.

The curves show the irons with nickel-chromium to be stronger on transverse test than those where these elements are absent.

The low and medium nickel-chromium curves show stronger iron than where high ranges of these elements exist.

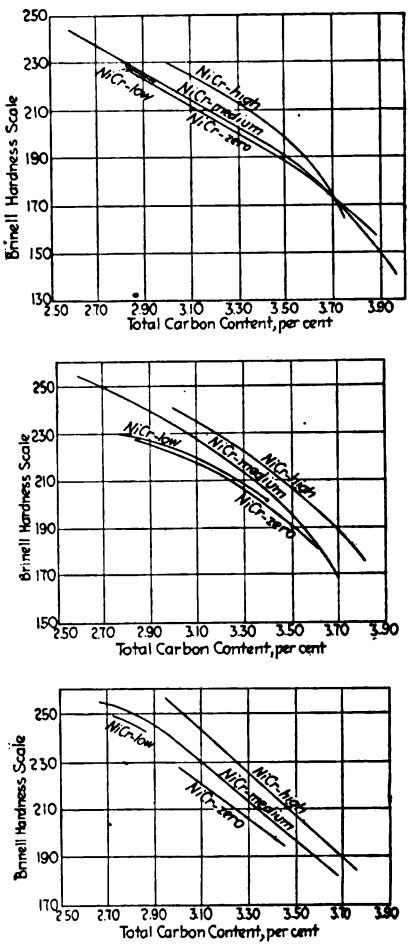
The best transverse strengths seem to have been obtained with the low to medium total carbon ranges, with 1.50 to 2.00 per cent. silicon and low to medium phosphorus and nickel-chromium.

The least transverse strengths were obtained with a high total carbon, silicon above 2.00 per cent., and with nickel-chromium either zero or high. The phosphorus in these cases seems to have been negligible.

A study of the deflection curves show:

The general tendency of the deflection curves for all ranges of total carbon is to go upward as the silicon content rises.

The deflection of the test pieces (when at the breaking point) is greater as the total carbon goes up, or again the reverse of the transverse results.




Brinell number curves.

The deflection drops as the phosphorus content increases, showing that the lower phosphorus ranges give better deflections, or more resilient iron than the high ones.

The nickel-chromium content seems to run with the phosphorus in this series of deflection curves, for the greater deflections are with no, or but little, nickel-chromium.

The greatest deflections seem to have been obtained when the total carbon was medium, the silicon above 2 per cent., the phosphorus low, and the nickel-chromium either absent or low.

The least deflections are found in irons of low total carbon and silicon, with high phosphorus and nickel-chromium.

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The tensile-strength curves show the following:

As in the transverse tests, the trend of the curves for all the total carbon ranges is generally downward as the silicon increases.

As in the transverse tests, the tensile-strength ranges go downward as the total carbon goes up.

In general, with the low to medium total carbons, the low nickel-chromium with the low to medium phosphorus ranges give better tensile strengths than high phosphorus with either zero or high nickel-chromium.

An examination of the curves, arranged according to a regular progression of total carbon percentages, and grouped according to the phosphorus ranges with the silicon content ignored entirely, shows the following:

All the curves show that the higher the total carbon, the lower the Brinell numbers, or softer the metal; and *vice versa*.

Whether phosphorus is low, medium, or high, the element in question evidently has but little effect on the hardness of cast iron as compared with that of the total carbon content.

The effect of nickel-chromium is definitely marked as increasing hardness with rising percentages.

There would appear a general showing that the conception of hardness in cast iron and strength must be kept distinctly apart, and that further investigations should be made to get more information on this subject.

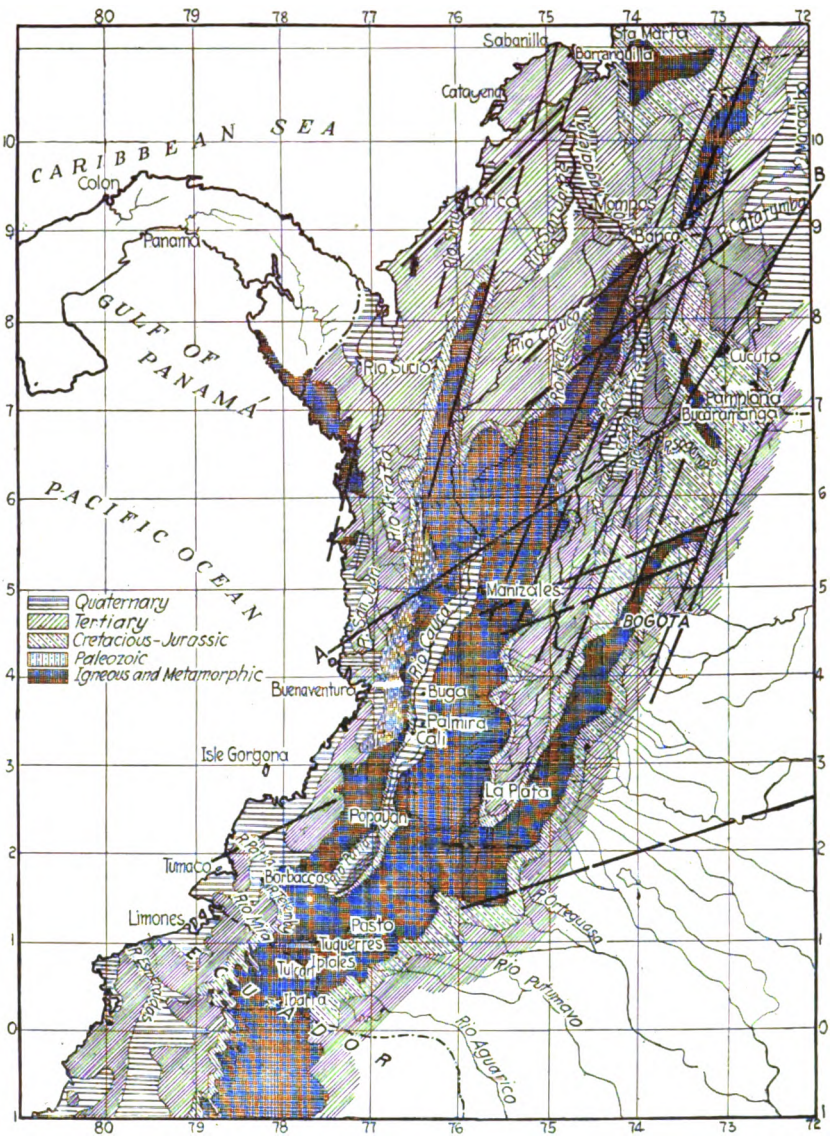
## Colombian Oil Fields

By L. G. Huntley and Shirley Mason, Pittsburgh, Pa.

THE Colombian highlands consist of three parallel mountain ranges called respectively the eastern, central, and western cordillera of the Andes. A segment of the range that forms the backbone of the Isthmus of Panama also extends into Colombia, along the Pacific coast, as far southward as the mouth of the San Juan River.

The predominant sedimentary formations in Colombia are those of Tertiary age. They form the floor of the Magdalena River valley and the coastal plain that borders the Carribean Sea: this is also true of the southern part of the narrow coastal belt of the Pacific Coast. They are usually of great thickness, as shown in their exposures along the flanks of the eastern cordillera, and along the folds of the more recent coastal uplift from Barranquilla to the Gulf of Urabá. These are the two regions of greatest promise for oil production in the next generation.

The lower portion of these Tertiary sediments is of the greatest value as a source of oil; this is usually called the coal series and includes numerous beds of coal, which sometimes are 30 ft. thick. This is probably the equivalent of the Pavji series of the Lake Maracaibo district.




AREAL GEOLOGY OF COLOMBIA. DASH LINES INDICATE DIRECTION OF FOLDS AND FAULTS.

This coal series contains petroliferous shales and slates, and at the outcrop presents a number of oil-saturated sands. It is underlain by black slates and limestones of Cretaceous age, which are also petroliferous at the outcrop. The lower portion of this latter series has marine fossils, which may be of Jurassic age. The lower Tertiary coal series and the underlying Cretaceous represent the probable source of all the oil that will be found in the Magdalena valley. All of the seepages found in this region are exudations from these sediments or from those closely in contact with them.

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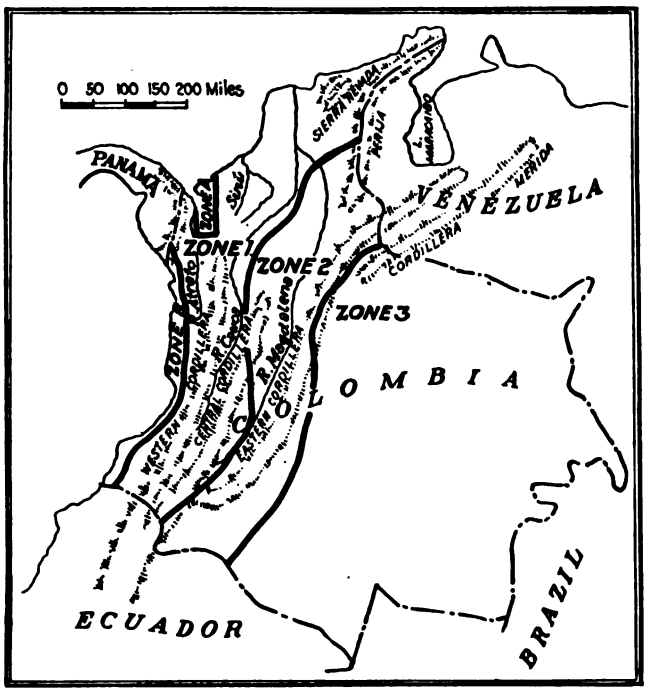
Along the coastal uplift, these oil shales and sands usually lie at considerably greater depths than they have been found on the folds in the Magdalena valley. The overlying sediments in the coastal region are of such thickness that it is not likely that the underlying oil sands can be encountered by the drill except on a few




PETROLEUM ZONES IN COLOMBIA.

of the highest folds, where erosion has removed the upper beds. No past drilling has furnished conclusive evidence of the presence or absence of oil in this coastal uplift, as all wells have been either badly located, from a structural standpoint, or were not carried to a sufficient depth to test their respective localities.

The Tertiary formations of the west coast are not favorable for oil, being largely composed of sandy clays and clay shales, with little or no organic matter.

The hope of success in prospecting for oil in Colombia will be restricted to four general regions, which may be listed as follows, in their order of promise:

1. Magdalena valley, particularly the eastern side.
2. Northern coastal plain, from Barranquilla to the Gulf of Urabá.
3. Headwaters of the Catatumbo and Rio Oro on the Venezuelan border, on the eastern flank of the Eastern Cordillera of the Andes.
4. Territory drained by the headwaters of the Rivers Meta and Caquetá, on the eastern flank of the Andes.

The entire question for the immediate future resolves itself in the oil possibilities of the lower Magdalena valley and the northern coastal plain. The writers believe that there is in these two districts a large oil reservoir which can be exploited profitably, although this can probably be done to best advantage by adapting California methods rather than those of the Mid-continent fields. The proximity of the Panama Canal makes northern Colombia a strategic point of oil production.

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## Shot-firing by Electricity

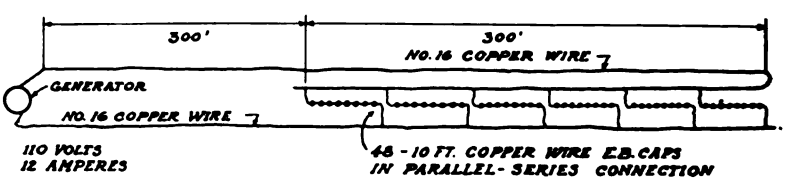
BY N. S. GREENSFELDER, WILMINGTON, DEL.

THE firing of explosive charges by electricity dates back to 1745 when a Doctor Watson is said to have used an electric spark for igniting gunpowder. His method failed in practical application because, to ignite blasting powder, heat must be applied for a period longer than the duration of an electrostatic spark.

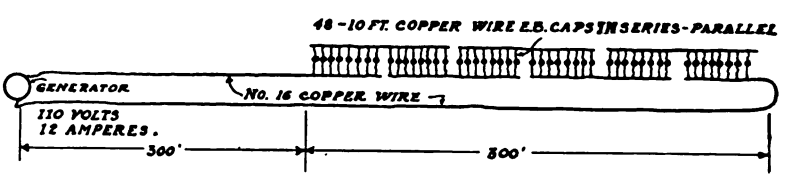
The development of electric shot-firing and the discovery of fulminates is traced from these early dates and an adequate description of the various apparatus required and methods used is given. Electric blasting caps, squibs, and blasting machines, lead and connecting wires and galvanometers, ohmmeters, and rheostats are described and the methods of calibrating galvanometers.

Methods of parallel-series and series-parallel connections are described and discussed, also the kind of current best adapted to the purpose.

The advantages of electric shot-firing in metal mines are many, and in coal mines the U. S. Bureau of Mines has for years recommended electric shot-firing on account of its greater safety. Outside and open-pit firing are also treated.




PARALLEL-SERIES CONNECTION.




SERIES-PARALLEL CONNECTION.

Electric shot firing is preventing waste and reducing costs at a number of large tunneling operations. Several ingenious methods of firing solid explosives by electricity for shooting oil wells have been devised which give good results in deep wells with increased safety.

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# Correspondence and Discussion

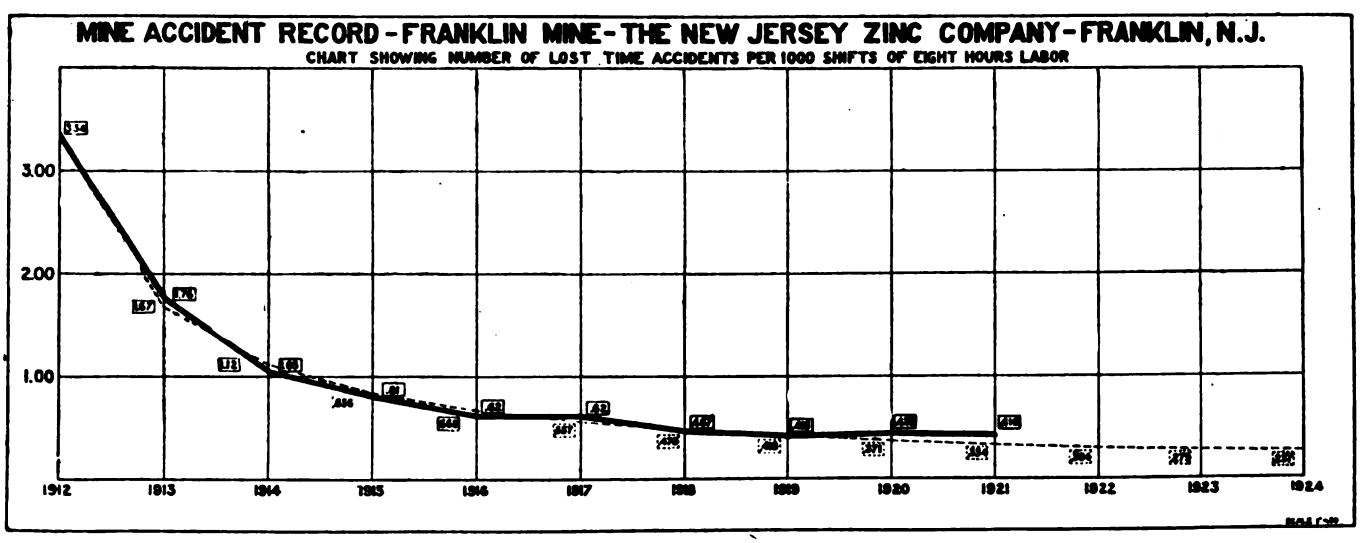
## Mine Accident Prevention

THE following data, collected at the Franklin mine, are of a nature similar to those supplied by Mr. Boardman[1] and may be of comparative interest, although in the chart of lost-time accidents rated per 1000 shifts of labor, the fatalities and total permanent disabilities have been included as lost-time accidents, and if the rates are comparable to those of Mr. Boardman's they would be slightly less than we have shown. Mr. Boardman states that the accident records which he quotes are for the Butte mines and shops; ours are for the Franklin mine and the only shop included is the mine blacksmith shop, which is devoted entirely to the sharpening of drill steels. If our general plant shops were included, the accident rates would be lower.

I am glad to see you publish Mr. Boardman's article, as the more that is printed of this nature, the greater interest will be aroused in mine safety.

BENJAMIN F. TILLSON.

Franklin, N. J., April 29, 1922.




*Accident Statistics, Franklin Mine*

| Year | Lost-time Accident Rate per 1000 Shifts (8 Hr.) Labor Worked | Time Lost per Disability (Exclusing fatalities and total permanent disabilities) Rated in 8-hr. Shifts | Hours Lost per 1000 Hr. Worked |
|---|---|---|---|
| 1912 | 3.34 | | |
| 1913 | 1.76 | 10.13 | 17.50 |
| 1914 | 1.05 | 12.65 | 13.20 |
| 1915 | 0.81 | 10.12 | 7.96 |
| 1916 | 0.62 | 10.42 | 6.27 |
| 1917 | 0.62 | 10.58 | 6.35 |
| 1918 | 0.47 | 12.52 | 6.97 |
| 1919 | 0.41 | 16.00 | 7.94 |
| 1920 | 0.43 | 8.91 | 3.89 |
| 1921 | 0.42 | 18.80 | 7.70 |
| Average 9 years... | 0.68 | 11.50 | 7.65 |

[1] See page 33.

## Oil and Gas Education

THE Committee on Education of the Oil and Gas Section of the Institute wishes to make explanation with reference to the letter of Professor Young, of the University of Kansas, printed in the August number of MINING AND METALLURGY.

The committee has tried to obtain accurate and full information regarding the work in petroleum geology and technology given in the various institutions of the country. To this end, the committee wrote to the schools in the spring of 1921, asking for information as to the courses given, the number of hours a week, number of weeks, students enrolled, and a copy of the catalog. We again wrote to the schools in December, 1921, and January, 1922, in order that our information might be up-to-date.

The information in our tabulation concerning the

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work given at the University of Kansas was obtained from that institution, in response to our inquiry, with their letter of March 23, 1921. We again wrote to the University of Kansas on Jan. 18, 1922, but so far have not received a reply to our inquiry, nor have we received a catalog, although we asked for one several times.

The subjects of subsurface and field geology, which Professor Young has listed, were not included in the tabulation, as they are given in most geological courses whether or not there is any work in oil and gas geology and technology connected with them. The original report was of the status of a certain date as well as could be obtained then, and I think has served its purpose.

ROSWELL H. JOHNSON.
Committee on Education.

# Government Papers of Interest to Engineers

## Investigations by the Bureau of Mines*

**Epsomite** (Serial No. 2333; 5 pages). By Raymond B. Ladoo.—The Bureau of Mines frequently receives requests for information on the mining, preparation and marketing of epsomite or Epsom salt, and therefore the information in this paper has been compiled.

**Tests of Hand Extinguishers on Zinc-dust Fires** (Serial No. 2335; 6 pages). By S. H. Katz and J. J. Bloomfield.—Fires in zinc dust have sometimes given particular trouble owing to their resistance to extinguishers and the liability of explosions. Small tests were made with water, sodium carbonate solution, carbon tetrachloride, silicon tetrachloride, and a frothy mixture as extinguishers for zinc-dust fires. The frothy mixture extinguished the fire most quietly and effectively, so it was tested on a larger fire in 300 lb. of zinc dust. Three 2½-gallon foam extinguishers smothered the fire, but danger of re-kindling had passed only after elapse of several hours, due to retention of heat in the metal by the non-conducting foam blanket. Thermal data show that water, carbon tetrachloride, and carbon dioxide react with zinc with liberation of considerable heat, carbon tetrachloride producing most.

**Drilling and Dustiness of Metal-mine Air** (Serial No. 2339; 6 pages). By D. Harrington.—During the past few years there has arisen in Australia and South Africa an impression that wet drills actually cause undue quantities of finely divided ore and rock to rise into the air, these fine particles being chiefly attached to particles of fog or spray escaping from holes using water drills. In view of this situation and the fact that wet stopers are being rapidly introduced with considerable success in many of the metal mines of the United States, the writer, who has for the past five years been engaged largely in studying the dust problem in the metal mines of the West for the U. S. Bureau of Mines, has compiled the dust sampling of air of drilling places in 214 working places in 13 mines at time of drilling, using various types of wet and dry drills with upper, inclined, horizontal and some down holes.

The dust studies to date in metal mines of the United States by the U. S. Bureau of Mines indicate definitely that wet drills, when they are operating satisfactorily, aid decidedly in reducing dustiness of air in drilling places. If out of repair, they may throw into the air of working places a mist or fog, laden with minute mineral particles which are fully as dangerous as dry dust. If water or compressed air and water forced through the drill is under excessive pressure, there may be danger of escape of mist or fog laden with mineral particles, hence these pressures should be held below 100 lb. per sq. in. which, in general, is the practice in the United States. However, wet drills, even at their worst, give conditions much more healthful than do dry drills.

**Survey of Pacific Coast Petroleum Products** (Serial No. 2342; 9 pages). By Earl C. Lane.—The Bureau of Mines is making a survey of petroleum products manufactured on the Pacific Coast from California crude oils. California crude petroleum is known to differ in some characteristics from the crude oil produced in other parts of the United States, and the claim has been made that the present Federal specifications are unduly severe when applied to the products made from California crudes. The main purpose of the present survey is to determine whether these claims are justified. This report deals only with California gasolines. Other products, such as burning oil, fuel and lubricating oils, will be taken up later. The samples reported were furnished, in most cases, by the four large refining companies located on the Pacific Coast, although a number of samples of motor gasoline were purchased in the open market.

**Bibliography of Articles Relating to the Preservation of Mine Timber** (Serial No. 2343). Compiled by R.

*Reports in full may be obtained from the Director of Bureau of Mines, Washington, D. C. Give serial number.

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R. Hornor.—Gives titles of 64 articles published from 1883 to 1921.

**Mica** (Serial No. 2357; 46 pages). By Oliver Bowles.—Mica includes a group of several minerals characterized by a perfect basal cleavage, by virtue of which they may be split into exceedingly thin plates. The minerals are of very common occurrence in all countries, constituting about 4 per cent. of the igneous rocks of the world. There are several varieties of mica, such as muscovite (known as potash or white mica) phlogopite or amber mica, biotite or black mica, paragonite or sodium mica, lepidolite or lithium mica, lepidomelane or iron mica, roscoelite or vanadium mica, and others. Muscovite and phlogopite are the only ones that are of importance commercially, and other varieties are described only briefly in this paper. In a recent year Canada, the United States, and India produced about 97 per cent. of the world output of sheet mica.

**Spring Canyon Mine Rescue Association** (Serial No. 2361; 3 pages). By A. L. Murray.—This is a coöperative association supported by five coal mining companies in Spring Canyon, Utah. The properties of these mining companies are about a mile apart and normally employ a total of 915 men, 733 underground and 182 on the surface.

The organization of this Rescue Association is a decided benefit in affording facilities for trained men to be available at all times for handling emergencies not only at the coöperating mines but at all mines located in Carbon County. It is also doing much to promote safety and a more wholesome respect for safety orders and safe practices.

**Helium** (Serial No. 2363; 4 pages). By R. B. Moore.—Helium is one of the best examples of a discovery in pure science that has wide commercial application. This paper tells of discovery, method of obtaining and uses of helium. No production of helium is now in progress, but funds will probably be furnished by Congress to run the large plant at Fort Worth practically during the whole of next year. Under such conditions, from eight to ten million cubic feet of helium may be obtained. Two helium repurification plants have been constructed by the Army, and the Bureau of Mines is coöperating in installing the final liquefaction equipment. One of these is at Langley Field, Va. The Government's entire helium program is now carried on under the general authority of the Army and Navy Helium Board, consisting of a representative, each, of the Army and Navy, together with a delegate from the Bureau of Mines.

**Ignition of Coal Dust by Electric Arcs** (Serial No. 2365; 7 pages). By L. C. Ilsley and E. J. Gleim.—The extensive use of pulverized coal for fuel in industrial plants has brought to the front again a question that heretofore has been considered only a mining problem, namely, "Can coal dust be ignited by an electric arc?" The numerous tests made by Thornton and Bowden should convince any one that coal dust in air can be exploded by electric arcs. The tests made by the Bureau of Mines proved that it can be accomplished with conditions that might prevail in a mine or around a pulverized-coal plant. The lesson from these tests is that coal dust in air, without the addition of gas, can be exploded with electric arcs. If there is electrical machinery in places where coal dust is apt to collect in quantities capable of producing a dust cloud, such electrical machinery should be housed in compartments designed especially for use in dusty atmospheres. Under Schedule 2B the Bureau of Mines is prepared to conduct investigations looking towards the safety of electrical equipment for this class of service.

**Smokeless Fuel for Salt Lake City** (Serial No. 2341; 18 pages). By G. St. J. Perrott and H. W. Clark.—A consideration of the practicability of by-product coking of Utah coals for supplying smokeless fuel to domestic consumers of Salt Lake City.

# Increase of Membership Department

**Total membership as of Aug. 12, 1922, is 10,168**

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period July 15 to August 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse

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of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—William Bernard Blyth,** Oxshott, Surrey, England.
Present position: On leave.
Proposers: D. A. Sutherland, J. A. Henderson, P. St. John Dixon.

**2—P. Dewees Browning,** Windber, Pa.
Present position—1920 to date: Mining Engineer, Berwind-White Coal Mining Co.
Proposers: E. J. Newbaker, Howard N. Eavenson, R. M. Raymond.

**3—James Sollitt Colbath,** Manila, P. I.
Present position—1919–22: Genl. Mgr., Dolores Espuaya Corpn.
Proposers: Clyde Milton Eye, Frank L. Sizer, Donald F. Irwin.

**4—Archibald Warren Diack,** Los Angeles, Cal.
Present position—1907 to date: Senior member of firm of Diack & Smith, Consulting and Qualified Chemists, of Detroit, Mich.
Proposers: F. B. Close, E. E. McIntyre, Leslie C. Mott.

**5—Lawrence Eddy,** Middletown, O.
Present position: Mechanical Designing on Metallurgical Plants, D. P. Robinson Co.
Proposers: H. N. Spicer, Philip L. Gill, D. S. McAfee.

**6—Shinsaku Hayashi,** Gotoji, Tagawa-gun, Fukuoka-ken, Japan.
Present position—1921 to date: Chief Engineer of the Electrical, Mechanical, Civil and Mining Engineering Department of Mitsui Tagawa Colliery.
Proposers: Takuma Dan, Tamaki Makita, Yoshima Sayeki.

**7—Victor Emmanuel Hillman,** Worcester, Mass.
Present position—1917 to date: Chief Chemist and Metallurgist, Crompton & Knowles Loom Works.
Proposers: John H. Nelson, Edwin H. Peirce, Rea C. Helm.

**8—Hilbert Caulfeild Jenison,** Washington, D. C.
Present position—1919 to date: Geologist in charge of copper, U. S. Geological Survey.
Proposers: George Otis Smith, Frank L. Hess, Sidney Paige.

**9—Frank Sigismund Loeb,** Pittsburgh, Pa.
Present position: Assistant to President, Duquesne Reduction Co.
Proposers: John T. Brown, Jr., G. E. Alderson, William G. Merten.

**10—Richard Douglass Montgomery,** Ancon, Canal Zone.
Present position: In charge of Geological Research and Drilling Operations.
Proposers: G. C. Gester, Carl H. Beal, S. H. Gester.

**11—Shiro Nakai,** Omuta, Japan.
Present position—1917 to date: General Manager, Miike Dyestuff Works of Mitsui Mining Co.

**12—Gen Nakane,** Gotoji, Tagawa-gun, Fukuoka-ken, Japan.
Present position—1919 to date: Engineer of the Electricial, Mechanical and Civil Engineering Department of Mitsu Tagawa Colliery.
Proposers: Takuma Dan, Tamaki Makita, Yoshima Sayeki.

**13—Albert Marvin Nash,** Spokane, Wash.
Present position: Director and Manager, Boston, New York Mining Co.
Proposers: L. K. Armstrong, M. J. Sweeny, Francis A. Thomson.

**14—W. W. Stevens,** New York, N. Y.
Present position—1919 to date: Consulting Engineer, The Texas Co., Export Department.
Proposers: G. S. Holmquist, Barnabas Bryan, Charles E. Herrman, Ralph Arnold, K. G. Mackenzie.

**15—George Edmond Taylor,** Charleston-Kanawha, W. Va.
Present position—1920 to date: Junior Partner, Anderson & Taylor, Consulting Engineers.
Proposers: J. K. Anderson, J. M. Clark, C. E. Krebs.

**16—Chitaru Tokushima,** Nihonbashi, Tokyo, Japan.
Present position—1914 to date: Mining Engineer, Mitsui Mining Co., Ltd.
Proposers: Takuma Dan, Tamaki Makita, Yoshima Sayeki.

**17—Charles William Wardle,** Copperhill, Tenn.
Present position: In charge of construction of a flotation plant, Tennessee Copper Co.
Proposers: J. N. Houser, Ralph A. Watson, Lapsley W. Hope.

Associates

**18—Ionel I. Gardescu,** Pittsburgh, Pa.
Present position: Geologist with R. E. Davis, Cons. Engr.
Proposers: S. G. Huntley, Paul Ruedemann, R. E. Somers.

**19—John Lundberg, Jr.,** Idaho Falls, Ida.
Present position: Levelman and Asst. to Office Engineer in drafting, also with J. H. Stemmer and F. H. Souther, on location.
Proposers: J. H. Stemmer, E. H. Wells, W. G. Ramlow.

**20—Harry M. McAlarney,** Wallacton, Pa.
Present position—1920 to date: Manager, Coal Mines, Emma Coal Min. Co.
Proposers: John Ira Thomas, Andrew Crichton, James H. Allport.

**21—Arthur Wallace Stedman, Jr.,** Brooklyn, N. Y.
Present position: Unemployed.
Proposers: Harry J. Wolf, Theodore Pilger, Frank A. Downes.

Junior Associates

**22—James Irving Corbett,** Menominee, Mich.
Student, Michigan College of Mines.
Proposers: F. W. McNair, J. B. Cunningham, F. W. Sperr.

**23—Albert Wright, Jr.,** Forest Hills, L. I.
Harvard College, B. A., 1922.
Proposers: F. G. Clapp, Barnabas Bryan, L. C. Graton.

Change of Status—Junior Associate to Associate

**24—Richard Paul Ernest Hermsdorf,** Roselle, N. J.
Present position—1920 to date: Assistant Metallurgist, U. S. Metals Refin. Co.
Proposers: W. C. Smith, S. Skowronski, Francis R. Pyne.

**25—Clarke Osborne Noble,** Santa Barbara, Cal.
Present position: Unemployed.
Proposers: R. M. Raymond, S. H. Ball.

**26—Russell Johnston Parker,** Tshikapa, Kasai Dist., Congo Belge, West Africa.
Present position—1919 to date: Junior Engineer, Société Internationale Forestière et Minière du Congo.
Proposers: S. H. Ball, C. F. Curtin, E. H. Dawson.

## Do You Know Where These Men Are?

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| Baird, David Birch, | Sigma Phi Epsilom House, State College, Pa. |
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| Frisbie, Howard I. | Race Track, Mont. |
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# Engineering Societies Library

**HARRISON W. CRAVER, Director**

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The Library offers, on payment for the extra work required, to supply photoprints or translations of articles, make searches for information, prepare lists of references and suggest books on engineering subjects. The cost of searching is $2 an hour. Translations cost $6 and upwards per thousand words. Typewritten copies, $1 a thousand words. Photoprints, 11 by 14 in., cost $0.25.

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The Library is at the service of every member. Those who cannot visit it may order searches, translations, copies, etc., by mail.

Address correspondence to the Director of the Library, Harrison W. Craver, 29 West 39th St., New York.

## Book Notices

**Chemical Technology and Analysis of Oils, Fats and Waxes.** Vol. 2. By J. Lewkowitsch. Sixth edition, revised by G. H. Warburton. Lond., Macmillan and Co., Ltd., 1922. 959 pp., illus., tables, 6 × 9 in., cloth, $14.

The second volume of the new edition of this popular treatise is concerned with methods of preparing, refining and examining the natural oils, fats and waxes, and of detecting adulterations. It is an exhaustive summary of present knowledge upon its subject.

**Les Colloïdes.** Par J. Duclaux. Paris, Gauthier-Villars et Cie, 1922. (Actualités scientifiques.) 305 pp., 5 × 7 in., paper. 10 fr.

This work does not purport to be encyclopedic. It is, rather, a concist statement of chosen facts woven into a coherent account, from a single poine of view, with useless details and superimposed theories avoided. Certain modifications have been made in the new edition. The author is director of the Laboratory of the Pasteur Institute.

**Mathematical Theory of Probabilities.** By Arne Fisher. Second edition, enlarged. N. Y., The Macmillan Co., 1922. 289 pp., 6 × 9 in., cloth, $5.

The author's aim has been to treat all the modern researches upon this important branch of applied mathematics from a common point of view, based on the mathematical principles laid down by Laplace, and to present a theory of probabilities as developed in recent years of value to the practical statistician, the actuary, the engineer and the biologist, as well as to students of mathematics.

The second edition is extended to nearly twice its original size by added chapters on frequency functions and their applications. M. C. Rorty contributes an introductory note indicating some of the practical applications of the theory of probabilities to business problems.

**Steam Turbines.** By William J. Goudie. Second edition. Lond. and N. Y., Longmans, Green and Co., 1922. 804 pp., plates, diagrs., illus., 6 × 9 in., cloth. $10.

Primarily for engineering students, but the methods of calculation outlined will be useful also to engineers engaged in design or operation of steam turbines. The first part gives detailed descriptions of types now on the market. The second part treats what may be termed the "technical" part of the subject; nozzles, blading, rotors, gearing, steam consumption, proportions, governing, etc. This edition has been completely rewritten and enlarged.

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# Employment Service Bureau

**Under joint management of the national societies of Civil, Mining, Mechanical and Electrical Engineers.**

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

The Employment Service Bureau sends a weekly bulletin, giving lists of positions vacant, to secretaries of local sections and also to secretaries of affiliated student societies.

## Men Available

**After Oct. 1, 1922, no person other than a member of one of the four Founder Societies will be registered with the Employment Bureau under this heading.**

**Metallurgical Engineer.**—Fourteen years experience with electric furnaces producing steel, cast iron, and ferro-alloys. Open for immediate engagement, production or research. IM–1627.

**Mining Engineer.**—Graduate. Twelve years experience. Specialized executive in practical mine operation, engineering, development and office methods. Desires connection with mining or allied industry. New York City interview. IM–1628.

**Construction Engineer.**—Experience: Two years highway work including estimating, designing and construction; one year, chief draftsman large mining company; one-half year, chief engineer construction company; two years, telephone work, central office equipment layout and installation; three years, surveying and railroad location. Single. Limited knowledge of Spanish. Will go anywhere. IM–1629.

**Mining Engineer.**—Graduate. Experience as mining engineer, two years; business not connected with the engineering profession, one year. Desires change to position combining selling service supplemented by a college engineering course. IM–1630.

**Mining Engineer and Superintendent.**—Graduate, with seven years experience in iron, chrome, asbestos and slate mining and milling. Age 33. Married. IM–1631.

**General Superintendent or Manager.**—Technically and practically proficient in mechanical electrical end of mining and milling. At present in charge of all the mechanical electrical work, including operation and maintenance of railroad and mill, of large mine. Judgment and training qualify him for general superintendent or manager where a wide experience in geology is not paramount. Salary at least $6000 per year. Age 38. Married. IM–1632.

**Technical Graduate.**—Eight years experience, concentration of tin ores; intimate knowledge of tin mines of Bolivia; broad experience in management of men and plants; fluent Spanish. Desires position with future. Age 33. Married. IM–1633.

## Positions Open

**Persons applying for any of the following positions will please place their names, addresses and initials of the society to which they belong (A. S. C. E., A. I. M. E., A. S. M. E. or A. I. E. E.) on the outside of the envelopes containing the applications.**

**Chemical Engineer** who has had actual experience in putting up naphthalene plants. Apply by letter. New York City. V–1627.

**Engineer** to take charge of erection and operation of plant refining mixture of lead and antimony carrying a quantity of silver. Apply by letter. V–1633.

**Engineer** having some or all of following qualifications: Experience in design of industrial electric furnaces; experience in application of industrial electric furnaces; such general metallurgical and industrial experience as would enable engineer to apply industrial electric furnaces after brief special training. Apply by letter. Pennsylvania. V–1894.

**Mining Engineer.**—Graduate, with broad mechanical experience for diatomaceous earth plant. Age 30 to 40. Must be willing to do drafting and layout of equipment; also install and operate plant. Milling experience essential. Apply by letter. Oregon. V–1896.

**Engineer.**—Graduate, versed in mathematics; heat balance, etc., of industrial drying as applied to chemicals, textiles and leather, for calculations, tests and sales. Also wanted, men to train for salesmen. Apply by letter. V–1901.

**Mechanical Engineer.**—Four or five years power engineering experience, testing of power-plant apparatus and consumption of steam, air, water, electricity, etc., of industrial plant equipment. Tact and diplomacy required, to obtain the coöperation of plant operatives over whom he would have no direct authority. Apply by letter. Delaware. V–1906.

**Chief Draftsmen** for company manufacturing air compressors and steam and power pumps, 12-in. stroke and shorter. Man who can keep line up-to-date. Apply by letter. Illinois. V–1910.

**Engineer** for editorial department particularly for outside work. Must be familiar with power plant machinery and practice. Should have good personality and be capable of meeting important men and securing good will and coöperation, and have broad view as to future progress of power plants. Age about 35. Experience in editing not essential. Apply by letter. Illinois. V–1921.

**Instructor** in mechanical drawing, descriptive geometry and mechanism, preferably with experience as teacher and some practical experience. Appointment for three years. Apply by letter. Constantinople. V–1928.

**Instructor** in mathematics, including descriptive geometry and surveying. Appointment for three years. Recent graduate preferred. Apply by letter. Syria. V–1929.

**Sales Engineers** for mineral oil paint extensively used by engineers and architects. Paint has record of success. Commission basis. Apply by letter. Headquarters, New York City. V–1934.

**Topographical Draftsman.**—Three months work. New York City. V–1951.

**Sales Engineer** experienced in handling overhead cranes, trench excavators, gasoline shovels, and gas engines. Single, not over 30 years old. Apply by letter. New York City. V–1955.

**Sales Engineer** for broad line of crushing machinery. Technical education and some operating and sales experience desired. Apply by letter. Headquarters, New York City. V–1956.

**Sales Engineer** with executive ability. Apply by letter. New Jersey. V–1957.

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**Metallurgists** on steel castings for bottle molds in electric foundry. Apply by letter. Ohio. V–1998.

**Draftsman** for design, checking and detailing of chutes, hoppers, etc. Must have experience on conveying machinery. New York City. V–2009.

**Draftsman** experienced on fuel-oil piping layout for furnace work. Apply by letter. New York City. V–2053.

**Chemist or Chemical Engineer,** Ph. D., about 30 years old, experienced in teaching or practical work along analytical lines, as instructor at university. Apply by letter. Washington, D. C. V–2056.

**Mining Engineers** (2) for alluvial diamond mining. Single, 24 to 30 years old. Apply by letter. Africa. V–2060.

**Mining Engineer.**—Recent graduate for underground work. Apply by letter. Pennsylvania. V–2061.

**Mining Engineer** for underground work; 2 to 3 years experience. Apply by letter. Pennsylvania. V–2062.

**Mine Superintendent** of talc mines familiar with non-metallic or coal mining. Technical graduate. Apply by letter. Vermont. V–2080.

**Expert Accountant** for mining property in Nevada, including large construction job just being initiated. Single man preferred. Apply by letter. V–2094.

**Sales Executive** with broad knowledge of industrial field to carry on an educational industrial campaign among manufacturers. Complete details required. Apply by letter. Headquarters, New York City. V–2097.

**Designer** experienced on fuel-oil burning equipment. To act as adviser on commercial and engineering development work. Apply by letter. New York City. V–2098.

**Concrete Designers** (2), on heavy concrete construction in connection with power house design. New York City. V–2118.

**Recent Mechanical Engineering Graduate** for shale-oil industries. M. I. T. man preferred. Apply by letter. V–2123.

**Technical Graduate** out of school one year. Experience in heat treatment desirable. Apply by letter. Philadelphia, Pa. V–2128.

**Engineer** interested in design and construction of rotating electrical apparatus to take up designing with manufacturing company. Experience desirable, technical training essential. East Pittsburgh, Pa. V–2136.

**Associate Editor** for engineering journal. General qualifications: Age 28 to 35; engineering education, preferably mechanical; shop experience, preferably as executive; some editorial experience, or its equivalent; personality, the ability to mix. New York City. V–2117.

# Industrial News and Developments

**Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.**

## New Keystone Trolley-wire Clamp

THE Electric Service Supplies Co., of Philadelphia, Pa., has placed on the market a new type of mine trolley-wire clamp or trolley car which is exceedingly simple in design, having only four parts: A machined steel center, two malleable iron jaws and a locking nut, permanently assembled and sherardized. The total height of the assembly is two inches.

The upper hexagon nut is screwed tightly against the suspension, then the jaws are aligned with the trolley wire and locked in position by the lower hexagon nut, which is fitted with a left hand thread. Two styles are listed, one for 2/0, 3/0 and 4/0 grooved wire and another for 2/0, 3/0 and 4/0 Fig. 8 wire.

ESSCO TROLLEY-WIRE CLAMP.

## Will Use Powdered Coal

UNION Electric Light & Power Co., a subsidiary of North American Co., will burn powdered coal in its new $6,000,000 power plant in St. Louis. This is one of the most important forward steps in engineering for some time. Contract for this equipment has been placed with Combustion Engineering Corporation for Lopulco system for burning pulverized fuel, which brings commitments so far for the first section of the plant to about $2,500,000. The new plant will have ultimate capacity of 240,000 kw., of which 60,000 kw. will be in operation next year.—*Boston News Bureau.*

## A Mine Scraper Bucket

A SCRAPER for mining use has been placed on the market by the Coöperative Utilities Co., Inc., of Philadelphia, to gather the loose material from the working face of a chamber and load it into a car in the entry. It was designed principally for use in thin-vein coal seams but it can be used also to advantage in thick seams or metal and non-metal mines for similar purposes.

The scraper bucket is practically a greatly widened scoop shovel, hinged at its back edge, on both sides, to two parallel iron plates, which confine the shoveled coal. Its scooping motions are automatically operated by a haul and tail rope from a double-drum hoist on the entry. The standard size is 66 in. wide, 74 in. long and 24 in. high, but the height can be varied to suit the thickness of the seam in which it operates.

## An Improved Pipe Wrench

THE "Little Giant," a pipe wrench with several interesting improvements, has just been put on the market. It has the end opening, which is familiar to users of machinists' wrenches, and its great advantage is the ease with which it can handle pipes in corners, close to walls, and similar confined places.

The "Little Giant" has only three parts: A handle and jaw in one piece, which is drop forged and heat treated; a movable jaw, also drop forged and heat treated; and a hardened steel nut. There are no springs, rivets, frame or pins. There is a double set of teeth on the main jaw. The movable jaw can be engaged with either of these sets. On the large sizes, 14 in. and greater, two additional sets of teeth are provided, and the movable jaw

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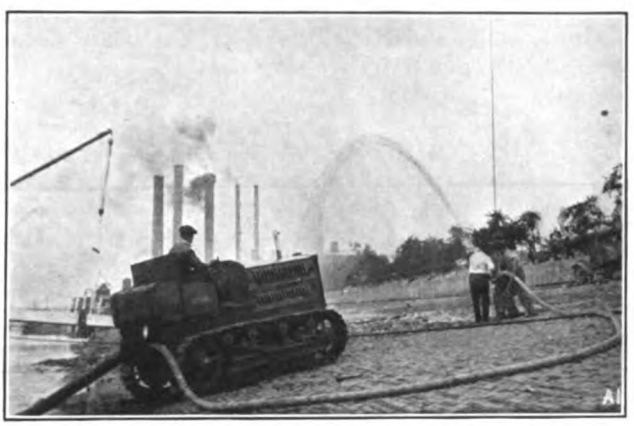
can be reversed to engage these additional sets, which are below the adjusting nut.

The 14-in. size of this wrench has repeatedly withstood stresses in excess of 4700 in.-lb. without slipping or bending.

The new wrench is manufactured by the Greenfield Tap & Die Corpn., Greenfield, Mass.

## Rotary Pump Attachment for 5-ton "Caterpillar" Tractor

THE Holt Manufacturing Co., Peoria, Ill., is offering a unique and practical accessory in the form of a rotary pump, which can be attached to the standard 5-ton caterpillar tractor. This pump, which was developed by coöperation of Holt engineers and the Goulds Mfg. Co. of Seneca Falls, N. Y., is of special design, compact in size, and is attached to the rear of the tractor in the same position as the power pulley attachment. It is driven through the countershaft from the motor and is capable of delivering 220 gal. of water per minute under working pressure of



ROTARY PUMP ATTACHMENT ON CATERPILLAR TRACTOR.

100 lb. per sq. in. At normal speed of 1000 r.p.m., it throws a 1⅛ in. stream 100 ft. in the air, and requires only 26 hp. As this is about two-thirds of the normal motor capacity of the 5-ton caterpillar, there is a large reserve for overloading, should the pump be called on for extra heavy duty.

In general design this pump is of the rotary gear wheel type, with all working parts mounted in a heavy cast-iron case which preserves perfect alignment. Although the pump is especially strong, for heavy duty service, it is light in weight, weighing only 225 pounds.

## New A.C. Motors

THE Mechanical Appliance Co., of Milwaukee, has placed on the market a new line of Watson A.C. Multi-speed Motors which provide for speeds of 600, 720, 900 and 1200 r.p.m., and which, in operation and application, afford very closely the wide range of speed variation formerly possible only in D.C. motors.

One of the serious problems in getting this line of motors ready for the market was development of suitable control apparatus. This has been thoroughly worked out and tried so that it may now be offered for both automatic and remote control, equipped with the latest protective apparatus which has been developed for use with this equipment.

The driving of machine tools and conveyors is facilitated by this new construction. Fans and blowers can be operated at a variety of speeds at high efficiency and without excessive current consumption particularly at a low speed. Air compressors and refrigeration machines can be operated with only a slight deviation from the exact speed required.

## Industrial Notes

**Hadfield Penfield Steel Co.,** Bucyrus, Ohio, announces that, in addition to his previous duties, Arthur Whitcraft, manager manganese steel sales, has been placed in charge of all foundry operations at the South Works, Bucyrus, Ohio.

**Bethlehem Foundry & Machine Co.,** Bethlehem, Pa., has acquired the capital stock, including all assets and equipment, of the Wedge Mechanical Furnace Co. of Philadelphia. The actual fabrication of the metal parts of Wedge furnaces has been done by the Bethlehem Foundry & Machine Co. ever since the introduction of the furnace, hence there will be no change in the quality of the product.

**E. I. du Pont de Nemours & Co.** announces that J. Thompson Brown has been appointed general manager of the Explosives Department, to succeed the late Charles A. Patterson. Mr. Brown was first employed by the du Pont company in 1903 and has been engaged in plant engineering and special and general operating work at the high-explosives plants.

**Maple Leaf Asbestos Corpn., Ltd.,** has opened a general sales office in the Canadian Pacific Bldg., 342 Madison Ave., New York City. The corporation operates the Maple Leaf and Reed mines, at Thetford Mines, Canada.

## Trade Catalogs

**General Engineering Co.,** Salt Lake City, Utah.—Leaflet on Geco flotation-oil and reagent feeder.

**Hughes Tool Co.,** Houston, Texas.—Pamphlet describing and illustrating Hughes tool joints.

**Sullivan Machinery Co.,** Peoples Gas Bldg., Chicago, Ill.—Bulletin 69-O. Diamond Drilling for Oil.

Booklet 123—Portable compressors and rotators. Sullivan "WK-31" air compressors, gas engine drive, are recommended where a complete, portable independent air power unit is desired. The vertical, two-cylinder compressor will run two Sullivan rotators in all drilling ordinarily found necessary in road work. A smaller and simpler, and therefore less expensive portable compressor, type "WK-34" is adapted for operation by belt from a light tractor. When electric power is available from a transmission line, or feed wire, in city work, the class "WK-32" motor-driven compressor is suggested.

**Timken Roller Bearing Co.,** Canton, Ohio.—Timken Engineering Journal on Mine Car Wheels. This contains specific information for engineers handling the design of mine cars. An accompanying pamphlet, called "Thrust," points out advantages of Timken bearings on mine cars.

**The Metals Coating Company of America,** 495 N. Third St., Philadelphia, Pa., has issued a pamphlet describing the Schoop metal-coating process in which pictorial form rather than textual description has been used with unusual result. The process and apparatus are for simultaneously melting and atomizing any of the commercial minerals either in wire or dust form and impacting them on any surface. The apparatus applies, either in the shop or in the field, a coherent attached or separable coating of any of the commercial metals such as zinc, lead, aluminum, tin, copper, bronze, brass, nickel or monel metal on any surface, whether inflammable, vitreous, fibrous, metallic, conducting or insulating, regardless of size or location. It is used for coating bridge girders, chemical apparatus, large coils of pipe against corrosion, kettles, transmission tellers, chemical containers, water heaters, etc.

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# MINING AND METALLURGY

OCTOBER 1922


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***Engineers and Constructors***

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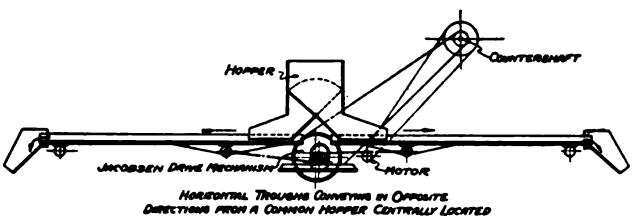

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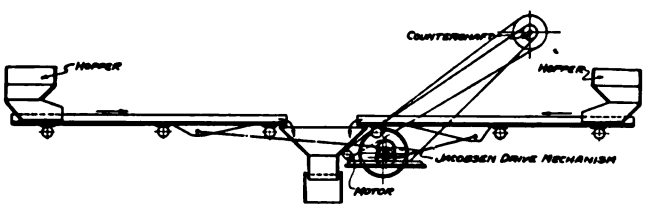

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**DESIGN AND CONSTRUCTION**
**OF**
**MODERN AND IMPROVED EQUIPMENT**
**FOR**
## COAL & ORE HANDLING PROBLEMS

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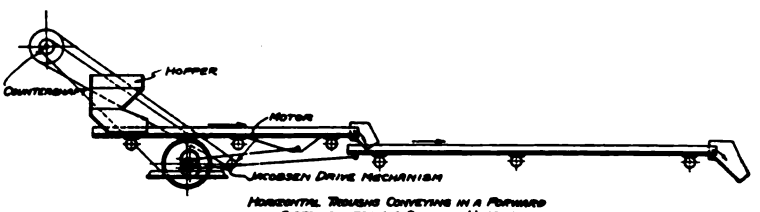

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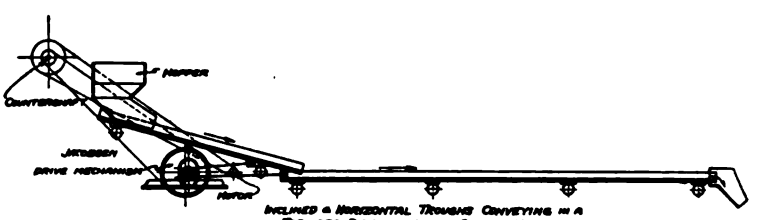

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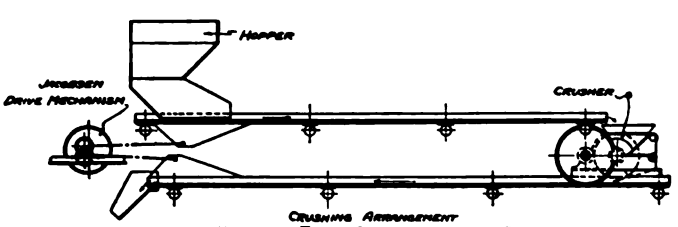
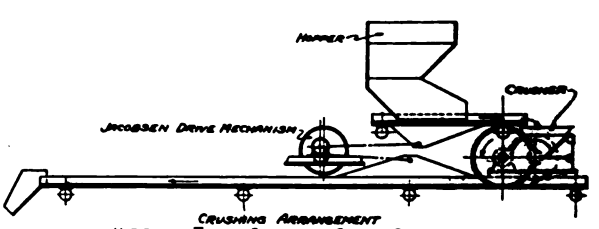


CRUSHING ARRANGEMENT
HORIZONTAL TROUGHS CONVEYING IN OPPOSITE DIRECTIONS



CRUSHING ARRANGEMENT
HORIZONTAL TROUGHS CONVEYING IN OPPOSITE DIRECTIONS

**ESTIMATES AND DESIGNS FURNISHED**

***Investigate our Equipment*** **Write to-day for Details.**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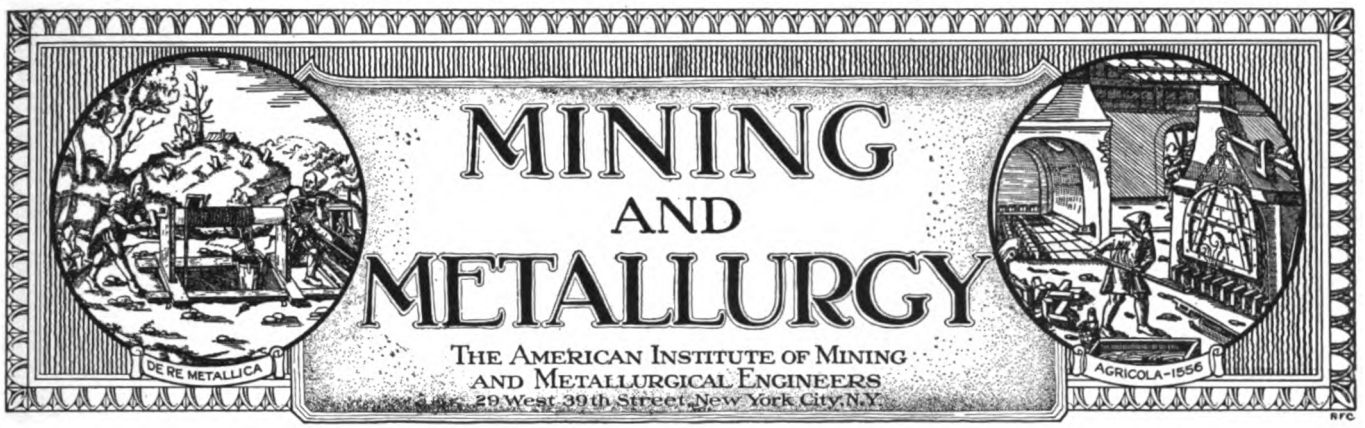


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## EDITORIAL

### The Meaning of the Strike Settlements

WITH the composition of the anthracite strike the administration in Washington breathed a sigh of relief. The politicians who were instrumental in bringing the thing about experienced a warm satisfaction in having allayed a pest that was plaguing them.

Some sentimentalists made pseudo-wise remarks about the need for henceforth viewing laborers as human beings, not as chattels or commodities.

Samuel Gompers declared that labor had checkmated a vast plot of employers against unionism, their plan including reduction of wages, establishment of non-union shops and destruction of effective resistance, *i.e.*, unionism, on the part of workers.

John W. Davis, Secretary of Labor, was gratified that labor, in spite of unemployment, had fought off all attempts to decrease the wage levels set up during the war and that workingmen grown accustomed to comforts in life not tasted before would now find them preserved throughout the future; and that continuance of high wages would bring such prosperity as never before by virtue of increasing the nation's consuming power.

Politicians, thinking of votes, like to avoid trouble. Sentimentalists often do not know what they are talking about. The labor leaders, of course, play their own selfish game and talk accordingly. Secretary Davis preaches in effect that the war was economically a good thing, which is plain nonsense. Let us see, therefore, what the successful resistance of labor in the campaign of 1922 would mean if it were a victory, not merely a truce; what it means anyhow.

About 150,000 anthracite miners, in monopolistic control of their industry, have succeeded in maintaining their wages at the war-time rate. That this spelled a continued high price for coal, to come out of other people who had suffered deflation in their incomes, was immaterial to them. They professed to be fighting against the operators; and even the President of the



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United States could see in this situation nothing but a contest between employers and workers; but the operators do not care what wages they pay except that with superior economic intelligence they understand that high wages mean high prices—and that high prices mean diminished consumption—and that diminished consumption means downfall, involving them along with the miners, but especially themselves inasmuch as their capital is tied up in the business. The real fight was not between the miners and the operators but between the miners and the public, as the operators recognized when they threw up their hands and said that they would surrender if the public were agreeable, and the politicians, assuming to speak for the public, assented.

The bituminous coal miners carried their point of having the public support about 700,000 of them in an industry that requires only about 500,000.

The railway men, although failing to have their own way, have nevertheless had things so fixed by legislation that they have suffered none but a trifling reduction of wages. Their number is about 1,750,000.

Deducting the non-union bituminous coal miners, we have about 2,300,000 workers in these groups, who are especially dictating terms to us. The total number of unionized workers is about 5,000,000. The total of all workers in the United States is about 42,000,000. It is well to bear these figures in mind. All of these workers and their families must have coal, the things that are made with the aid of coal, and transportation. Even the anthracite miner has to keep his house warm. However, he does not mind high cost of coal, for his high wages are more than offsetting. As between him and the railway man there is an exchange of plunder. The people who pay are especially the mill-workers of New England, and others like them. Any one of intelligence who works in a factory in Lawrence or Bridgeport ought to be able to see this. Some of them, to be sure, may establish little exactions of their ewn and pass part of their load on to classes that are even more helpless. Among the latter are elderly people and invalids, living on the income of their savings, general laborers, the small tradesmen, and largest class of all, the farmers. The rich do not use much more coal per person, or much more transportation, than anybody else and there are too few of them to pay the bill.

Consequently, when Secretary Davis says that labor having tasted of good things is going to keep on having them, he means to say that of a small part of labor, with the corollary that the major part is going to be deprived of even such good things as they used to have. That can be the only meaning unless labor has learned to make something out of nothing. Inasmuch as one of the good things whereof labor has tasted is the luxury of leisure, out of the ability to get a living by working only part of the time, the probability is that labor has not learned to make something out of nothing and is, in fact, producing less per thousand men per annum than before the war. Another way of putting these ideas is this—If every family had the wages for a good living according to the estimates of the labor leaders, the gross national income falls short by far of affording it. These are not mere assertions, but are statements based on the determination of facts, to which representatives of the labor unions have themselves assented.

These facts should receive more attention by the politicians, sentimentalists, pacifists and all others who are seeing things through timid, distorted or beclouded eyes; and they should, moreover, give thought to these words of Dean Inge, whose vision is clear enough:

> The workingman has no respect for either democracy or liberty. His whole interest is in transferring the wealth of the minority to his own pocket. There was a time when he thought that universal suffrage would get for him what he desires; but he has lost all faith in constitutional methods. To levy blackmail on the community, under threats of civil war, seems to him a more expeditious way of gaining his object. Monopolies are to be established by a pitiless coercion of those who wish to keep their freedom. The trade unions are large capitalists; they are well able to start factories for themselves and work them for their own profit. But they find it more profitable to hold the nation to ransom by blockading the supply of the necessaries of life. The new laborer despises productivity for the same reason that the old robber barons did; it is less trouble to take money than to make it.

Dean Inge, writing from the European standpoint, was perhaps unacquainted with the state of American conditions, which shows so clearly how organized labor is aiming to appropriate not only the fruit of past labor, but also that which is still to be earned; and not only the earnings of the unorganized, but also of the earnings of the weaker classes of organized labor itself. I do not pretend to know just what are the conditions in Europe in this respect, but in the United States it is not a case of the working man trying to transfer the wealth of the minority to his own pocket, but it is a case of a minority of working men trying to appropriate for themselves a large part of the earnings of other working men. The economic evidence shows that this is the truth.

I do not deprecate the desire of anybody to get for himself all that he can fairly. I do not dispute the right of classes of people to organize for the improvement of their position collectively, providing that they play the game fairly. I have no quarrel with the principle of collective bargaining.

I do object to any class organizing for its own profit by the creation of a monopoly by the exclusion of other workers by fear.

I do object to the system of national unionization that gives rise to sympathetic strikes and parcels out the right to work by jurisdictions.

I do object to organization, either national or municipal, that permits concerted action about functioning or non-functioning, without due notice of intention, in some essential supply, *e.g.*, the distribution of milk.

In objecting to these things, I have perhaps objected to the heart and soul of labor unionism, anyway to its

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muscular system, but theoretically my objection is not to labor unionism. My thesis is rather that the public should not allow labor unions to prey upon it; and in self-defence should break them up.

Without any doubt, labor unions sometimes get more for their members than the latter would get if they were non-unionized. I suppose this is true of the longshoremen and of the seamen. If that be the case it is certain that other people have to pay for it, for generally the effect of labor unions is probably a reduction in the income of labor as a whole. Labor unions are costly in maintenance. They produce great loss of time by strikes. They produce much greater loss by enforcing the employment of unnecessary men (*i.e.*, unnecessary for a particular job) and by reducing efficiency. By establishing the dead-level of mediocrity, or sub-mediocrity, good men among themselves are deprived of their opportunities, while the incompetent are being lugged along. Everybody knows members of unions who resent these conditions, but bow to them out of fear. The defeat of the railway mechanics in the recent strike and the substitution of company unions on some roads has conferred upon many meritorious men the opportunity for getting wages above the union scale, when they earn them.

The economic evils arising out of labor unionism are associated with the fallacy about a labor fund from which wages are derived and reflect ignorance, or disdain, of the truth that a people can divide only what it produces. In practice labor unionism curtails production and aims to obtain for a few a greedy share of a total that itself has limited. Labor unionism functions successfully only in the distribution of the national produce, whereof one union may get for its members more than their share, doing so at the expense of all other workers, including other unions. When labor leaders point to the general advance in wages during the last 50 years as an accomplishment of unionism they claim for themselves what invention, engineering and managerial organization have done for them. Organized labor, with the assistance of socialists, muddy minded "humanitarians," exponents of the "new freedom" and so forth, is trying to befog the issue. Business on a large scale is now mainly conducted through corporations. Organized labor expresses the opinion that corporate finances are juggled and spreads that view so generally that it is held by many people who ought to know better. It has become a popular fallacy that the corporations of the country, *i.e.*, "big business," are managed by "Wall Street," and that an abstraction from the earnings thereof is a praiseworthy winning from the "capitalists" who are "growing rich out of labor's toil."

There was never a more pitiful delusion. The managers of corporations would just as soon pay high wages as low wages, having in mind the transfer of the high wages to the shoulders of the public (just as the railway managers are complacent about the situation as to wages, freight rates and passenger rates that governmental authorities have arranged) were it not for the objection that they know that high wages spell high costs and high costs spell diminished business. The real fight is not between organized labor and management, but it is between organized labor and the general public. The sooner people awake to this, the better it will be for them.

The real meaning of the settlements of 1922 is therefore a sort of economic slavery so long as the condition is permitted to endure. The fact that strikers by the tens and hundreds of thousands could refrain from work for periods ranging from five to eight months, without suffering any severe, general hardship, reveals in itself that labor had been getting an unduly fat share of the previous produce of industry. Contrary to some opinion, the strike settlements do not set the stage for "an upward swing of the business cycle as irresistible as was the downward trend" that began just about two years ago.

W. R. INGALLS.

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## Responsibility for the Argonaut Disaster

THE dreadful disaster in the Argonaut mine in California, whereby 47 men were trapped underground and lost their lives by suffocation, aroused great sympathy for the families of the unfortunate victims and also for the mining officials who were responsible for them. The disaster drew emphatic attention to the subject of accidents in mining and inspired expressions to the effect that steps should be taken to prevent such things, even if new legislation were required.

There will be no dissent from these ideas, but it may be pointed out that the means for taking the proper steps have been plainly indicated to us for a good many years. In 1915, a committee of consulting engineers associated with the U. S. Bureau of Mines, under the chairmanship of W. R. Ingalls, the other members of the committee being Messrs. Channing, Douglas, Finlay and Hammond, published a report on this subject, which constituted *Bulletin* 75 of the U. S. Bureau of Mines. Included in this report was a specific draft for legislation, offered as a model to the several states interested in such legislation. This model bill specifically provided that it should

> be the duty of every operator of every mine * * * to maintain at least two outlets to the surface from such mine, or an underground communicating passageway between every such mine and some other neighboring mine, so that there shall be at all times at least two distinct and available means of access to the surface to all persons employed in such mine.

The proposed bill further provided a penalty for noncompliance with this requirement.

The engineers who drew this model bill foresaw recurrences of catastrophes like the Argonaut and would require by statute the doing beforehand of the very

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thing that had to be done in this case after the disaster; *viz.*, the driving of a connection with the adjoining mine. Had California adopted such a law and enforced it, the lives of these 47 men would not have been sacrificed.

Laws closely following the committee's model have been enacted in Arizona, Nevada, Missouri, Illinois and perhaps other states. In no case, however, has any of the states paid much attention to the committee's recommendations, except as to the technical provisions. In other words, the states that have enacted such new laws have followed the technical provisions formulated by the committee but have neglected to provide means for their enforcement.

The committee was very emphatic on those points. It said that the mining states should arrange for better mine inspection and should provide adequate funds for that purpose. It said, moreover, that mine operators and officials who failed to conform to the law should be punished, and likewise miners. The miners' unions have talked about the desirability of promoting safety in mining, but they have not taken kindly to the idea that any of their members should be punished for infractions of laws, although such infractions might put many men in danger.

The whole thing is before us, all worked out and ready for action, just as it has been for the last seven years. If the death of 47 miners in the Argonaut mine arouses public sentiment in favor of real action they will not have died in vain.

This would be a proper subject for the Federated American Engineering Societies to consider with a view to putting its shoulder to the wheel. It is exactly that kind of public service for which the Federated is constituted. It will prove its value as a public agent by taking up some of these matters that have been thoroughly worked up and have passed outside the field of engineering discussion.

PERCY E. BARBOUR.

## Afterthoughts of the Coal Strike

IF THE United Mine Workers will not let the American people have anthracite coal at a cheap price, the only thing for the people to do will be to turn to substitutes, such as bituminous coal, coke and fuel oil. A consequence of every previous anthracite strike has been substitution of bituminous coal in the power plants of the Eastern cities. For domestic use, anthracite is preferred to bituminous, but even so it is a dirty fuel, and costly not only for itself but also for stoking and removing the ashes. Householders await the offering of suitable burners for fuel oil and kerosene and the creation of local distributing systems. The petroleum companies may be expected to attend to this.

The first newly mined anthracite coal reached New York about the middle of September. The price for it was reported to be $1 per ton higher than last year, making the retail price, at the usual scale, about $14.50 per ton. The explanation of the advance was the need for defrayal of the overhead, maintenance and pumping expenses of the operators during the strike.

Although this will be a bitter pill for consumers and will make most of them indignant, the charge is fair enough. The public lost the strike, so the public ought to pay. The politicians assisted toward the incurring of this bill, but perhaps there is excuse for them, too. There were no leaders, speaking with authority, to make it clear that the miners were aligned against the general public and that the operators were only intermediaries with no particular concern beyond the preservation of the anthracite business, although we are bound to grant that they exhibited a greater sympathy for general welfare and better knowledge of what promotes it than the labor leaders have. In the end, however, they put the case squarely before the public and the public was silent, wherefore the public is going to pay.

The miners lost nearly half a year's wages although in the end they had their way. I do not know whether it is correct to say that they won the strike; but of course the operators did not win. The case is something like somebody's retort to the question as to who would win the war with the counter-question "Who won the San Francisco earthquake?" But there is no evasion as to who lost the coal strike.

W. R. INGALLS.

## Federated Support of Mining Law Revision

NO GREAT accomplishment is ever achieved without great effort and early defeat begets later success, so that disappointment over the present status of the Mining Law Revision is no reason for discouragement.

At the same time that word comes from Washington that the bill is pigeon-holed in the Committee on Mines and Mining, which is disinclined to take further action, comes word that the Federated American Engineering Societies is determined to keep alive the effort to secure this revision. Here is a real work that the Federated may do. The present bill is a concrete thing—not a report or investigation—but the definite result of a need growing in the mining industry through 50 years to an urgent demand for relief and reform from the present archaic law which breeds perjury and leads to litigation.

The committee appointed by the Bureau of Mines to investigate the mining law was composed of eminent members of the profession, one of whom is a vice president of the Federated. They were all fitted by education and training for the task. They all had intimate knowledge, by actual contact, of the nefarious and infamous practices common under the existing muddle of statutes.

The bill drawn by them will be a cure. It will be a

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benefit to the mining industry and the mining profession. It takes away no right which any person or class of persons now enjoys; it provides for doing by proper and not onerous means those things that are now done only illegally and onerously. It provides stimulus to a great industry at the expense of nobody, but for the benefit of all the people. It not only does not deny to the prospector any present privilege but it gives him greater opportunity and without the incentive to perjury as to his discovery and his location and assessment work that is common in every mining camp today. It goes further and gives him distinct advantages he never before possessed.

Every argument against the revised bill has been met openly and conclusively; the idealist features of the bill have been eliminated. But a small group of uninformed men have stood out against it and they have votes. They are in a sparsely settled country where small groups of votes mean much to those politicians who are guided solely by political expediency.

The Federated has in its reported intention to further the passage of this bill an opportunity to do itself the greatest credit, in line with the original purpose of its creation. Its efforts in this direction would draw to its support, as no other item on its program has done or could do, the united strength of the engineers in the mining profession. It is in a position to convince the engineers of the country, other than the mining engineers, of the virtue and value of this legislation. It is in a position to speak for the engineering profession of the country on an engineering need to Congress, with a weight of opinion that cannot be ignored. It is a great opportunity for the Federated, and in proportion to its zeal in the effort will its reward be measured by the engineers on whom it depends.

PERCY E. BARBOUR.

## Modern Galvanizing in Disrepute

IF THE time ever comes when the consumer learns that he always has to foot the bill, it is going hard with some American industries that have evinced a growing tendency to sell him the shadow for the substance. Now it is galvanized sheets that are being so lightly coated with zinc that the protective covering does not protect except in the cases where expert buyers insist upon specified quantities of coating per square foot of iron sheet. Those who do not do this get an inferior product which turns them from the use of galvanized sheets to the use of substitutes. This not only brings zinc into disrepute and curtails its use, when as a matter of fact it is the best metallic coating known for the purpose, but reduces the ironmakers' sale of sheets for corrugating.

In the Philippines, where the humidity of tropical climate is high, modern galvanized corrugated sheets rust before they arrive and are put in place while the old sheets that have been on houses for 30 years are still in good condition. This should not be a very pleasing subject for reflection by the iron and steel makers of sheets.

Repeatedly, it is brought out that our export trade, particularly to Latin countries and China, suffers because we do not or will not furnish the type of product they want but insist upon trying to furnish what we care to produce. American sheetmakers cannot compete in foreign markets if they will not coat their sheets with enough zinc to protect it during the long sea voyage and necessary storage, while the foreign makers exert themselves to make a proper product for the conditions for which it is required.

If the American consumer wanted a foreign product with an honest coating he would find that a high protective tariff was protecting the American manufacturers in producing an inferior product. These may be unpalatable facts, but a good cure is to sell the consumer the substance and not the shadow. The article on "What is the Matter with Modern Galvanizing?" by J. A. Singmaster, in this issue, should set them thinking. The galvanizers should present their side of the case.

PERCY E. BARBOUR.

## Urquhart Soviet Mining Agreement

A FORMAL agreement has been signed by Leonid Krassin, Soviet Minister of Foreign Trade and Commerce, and Leslie Urquhart of London providing for complete restoration of the title rights for ninety-nine years of the pre-war holdings of the Russian-Asiatic Consolidated, Ltd.

Last year, Mr. Urquhart spent five weeks in Moscow and then announced his inability to conclude an agreement with the Soviet Government on terms he regarded as safe and proper. Mr. Urquhart's views as to terms and conditions have not altered, but the past weeks have been marked by significant progressive changes in Russia's evolution and in this highly important contract she for the first time accepts the principle that foreign capital must be recognized and safeguarded as essential to the rehabilitation of her 140,000,000 people.

The Urquhart agreement constitutes a breach in the barrier which existed between the Soviet Government and the outside world and a resumption of general trade with Russia may follow. In London the Russo-Asiatic affair has all along been regarded as a test case.

The corporation proposes to resume operations on its properties forthwith and American engineering talent will again play an important part in the renewed exploitation of the gold, copper, zinc, lead and coal mines of Russia.

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# Review of the Month

AT THE beginning of September, the French eased their pressure against Germany and allowed the latter to be granted an arrangement for its reparation payments in kind according to the Lubersac-Stinnes agreement. The whole arrangement as to the German reparations is, however, but temporary.

The Greeks suffered a disastrous defeat at the hands of the Turks in Anatolia, which rapidly resulted in the expulsion of the Greeks from Asia Minor, the Turks occupying Smyrna about Sept. 10.

A few days after entering Smyrna the Turks sacked the city and finally set it afire, creating one of the most terrible destructions in history. At the same time their advance on Constantinople, together with their demands on the Allies, brought them directly in conflict with the latter and Great Britain prepared for a new war, with doubt as to the support of France, whose political interests in the Near East are as different as their economic interests with respect to Germany. The Turkish situation became thus a threat against the peace of Europe.

A revolution in Greece, followed by the abdication of King Constantine and the return of Venizelos to a function in the Government was one of the consequences of the defeat in Asia Minor.

Civil war continued in Ireland, with more or less bloodshed.

Economically there has been no change for the better in Europe. In Great Britain there are no signs of an important trade revival. In Germany and Austria things are worse. French, Italian and Spanish affairs continue in a bad way. In the United States business is represented as "booming," but many people are inquiring where is the boom?

About the middle of September Congress passed the tariff and the soldier bonus bills. The President signed the former and vetoed the latter, with a strong message that won praise among people who understand conditions. Congress tried to pass the bill over the veto, but failed. The President signed the tariff bill, which became effective Sept. 21. A severe handicap was thus imposed on American economics.

In the labor war in the United States the Pittsburgh Coal Co. finally surrendered the last position on the bituminous front. The anthracite operators surrendered and also the textile manufacturers of New England. Some of the railways made a deal with their mechanics, but the majority, having secured men enough, pursued their own course in disregard of the union. Without any doubt the railways won this strike, but except as a step toward the disruption of the national union there was but little material gain, the reduction in wages being only a little. An ominous event was the consummation of a new contract between the railways and the brotherhoods whereby the former agreed to maintain the present scale of wages for another year. The prospect for any abatement of freight and passenger rates is therefore dark. Indeed, the Interstate Commerce Commission denied an application for abolition of the Pullman surcharge, because the railways needed it in order to continue to pay high wages, forsooth!

The Arizona copper-mining companies announced advance of 10 per cent. in wages, beginning Oct. 1. The Montana producers made an advance of 50 c. per day, Sept 21, making the rate for miners $4.75 per day. The Lake Superior producers also granted advances of 10 to 15 per cent. Wage increases in the Coeur d'Alenes became effective Oct. 1. Miners were given an increase of 75 c. per day, raising their wages to $5; muckers 50 c., making their daily wage $4.50; and timberers 75 c., making their daily wage $5.50.

Wages have been increased in the Joplin district, machine men to get $3.75 per day and helpers $3.25, which are raises of 25 c. per day. The Oklahoma smelters advanced wages 50 c. per day, making the present rate $1 per day higher than at the beginning of 1922.

Some of the metal markets had spectacular upward movements in September. The buying and takings of the manufacturers of lead and zinc continued large and production being relatively low, at least in the case of lead, producers were able to raise their prices, to compensate for increased costs. Thus lead went up to 6.35 c., New York, spelter to 6.85 c., St. Louis, and blende concentrate to $40, Joplin. The copper producers were in a different position. Although the costs of domestic producers increased, those of foreign mines whose crude copper comes hither for refining did not increase, and so large a proportion of the copper output having to be exported the ability to command higher prices was less than in markets which are more closely domestic affairs. Consequently the price for copper merely held steady at 14 c. The iron and steel markets, on the other hand, were strong and rising, consumers being required to pay for the increased costs of production.

Announcement was made on Sept. 10 that Krassin, the Soviet delegate, had signed an agreement whereby the properties of the Russian Asiatic Corporation, Ltd., are to be returned to it in the form of a 99-year lease. This settlement will probably be followed by the return to Russia of some of the American engineers who used to work there.

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# Water in Blister Copper Bars and Pigs

By ALBERT R. LEDOUX
President, Ledoux & Co., New York City

SEVERAL years ago my firm was representing the Mt. Lyell Co. of Australia, which was shipping its blister copper to a refining works in the United States. After the contract had been running for many months, the superintendent of these works discovered that if water was poured upon the surface of the bars much of it would disappear into the interior through blow holes. Some experiments made by him showed that this could be a considerable amount, so that copper which had been rained on before it was weighed, although the surface appeared dry, nevertheless would contain water.

It had frequently occurred in our experience as samplers that the drillings from a lot taken by boring would come out quite wet, and in some cases, indeed, water would drip into the sample pan placed below the bars, due to the fact that the drill had penetrated a cavity or cavities containing water, which presumably got into the cavities at the time the copper was water-cooled after casting, there being, perhaps, no outlet to the surface. So far as I know, until this discovery at the refining works, no one had thought that rain could penetrate into the interior of blister copper, at least in any quantity sufficient to be considered.

## Moisture Determination Required by Refiners

Some experiments were made at the works in question which showed that the bars would lose about 0.2 per cent. or 0.3 per cent. of moisture when dried in the furnace. Thereafter, to save the trouble of determining this water in every lot, an average figure was agreed upon, which was deducted from the weight, in settlement. Gradually this fact became known at other refineries until now it has become the universal custom to stipulate in the contract that moisture shall be determined in each case. Of course if the exigencies of circumstance made it necessary, copper was sometimes weighed immediately after being rained upon, when not only was the surface wet but on some of the bars which were dish-shaped in casting there would be quite a puddle of water on the surface. This was allowed for in weighing, as was the presence of snow or ice which sometimes were found on these surfaces when the copper had been exposed to the weather under freezing conditions.

In all the Eastern refining works there are now special furnaces arranged for the determination of moisture occluded in the bars, and whatever is found is deducted from the gross weight of the shipment. So far as I know, this precaution is not taken when shipments are made to European refineries, and from time to time my firm gets letters from South American and other shippers, contracting for the first time for the refining of their product in the United States, and they are surprised, as was I, when their attention is first called to this possibility of moisture occlusion.

## Methods of Determining Occluded Moisture

To explain to and to satisfy our clients, from time to time we have had bars of their blister copper sawed across and photographed (see Figs. 1–4). The cavities shown, while not extending, in most cases, to any great depth, are frequently quite capacious in horizontal extension. I weighed separately one of the bars illustrated, then had the surface sprinkled with water to simulate a shower, and allowed the bar to dry in a hot sun until there was no sign of surface dampness. The weight had increased from about 242 lb. to about 242¾ lb. Another one similarly treated increased from about 252 lb. to about 253 lb. On another bar I made a dam around a small orifice, and through this small hole over a teacupful of water disappeared into the interior. These coppers are not low grade; their content averages over 99 per cent.

When the practice of determining this occluded moisture was developed, each works devised a furnace for drying, in accordance with the ideas of its technical experts, and the practice differs in each case. In one works, for instance, today, the sample bars chosen for the moisture determination are placed upon a tared iron car having no closed bottom, simply a grating on which the bars are placed. This car, after weighing, is run into a furnace heated by steam coils at a pressure of about 120 lb., which is equivalent to something over 300° F.; of course the temperature of the center of the furnace perhaps does not reach that figure at all times. In other cases the car is run into a furnace heated by coal or coke; in others the heat is obtained from oil and a pyrometer is employed, the heat being allowed to rise as high as 600° F. in some instances.

It has been found that when the iron or steel car is run into a furnace, the car itself will lose in weight

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FIG. 1.

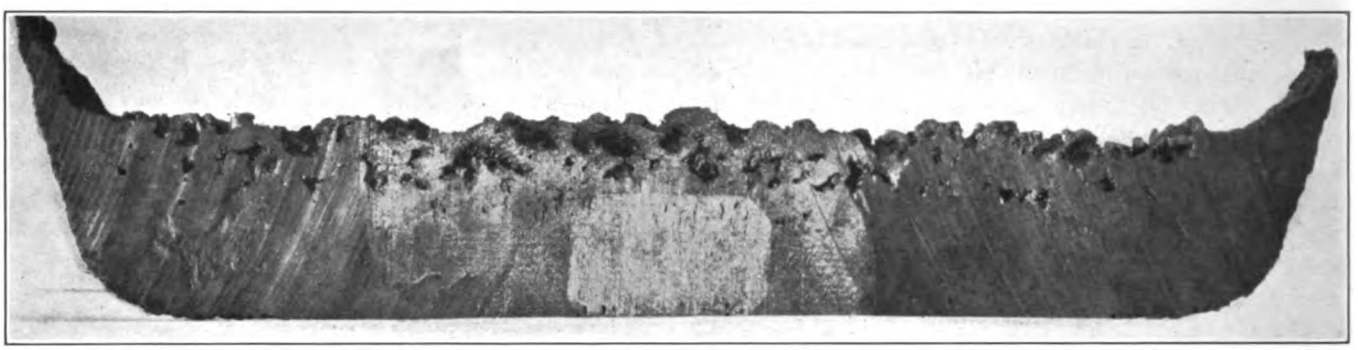

FIG. 2.

FIG. 3.

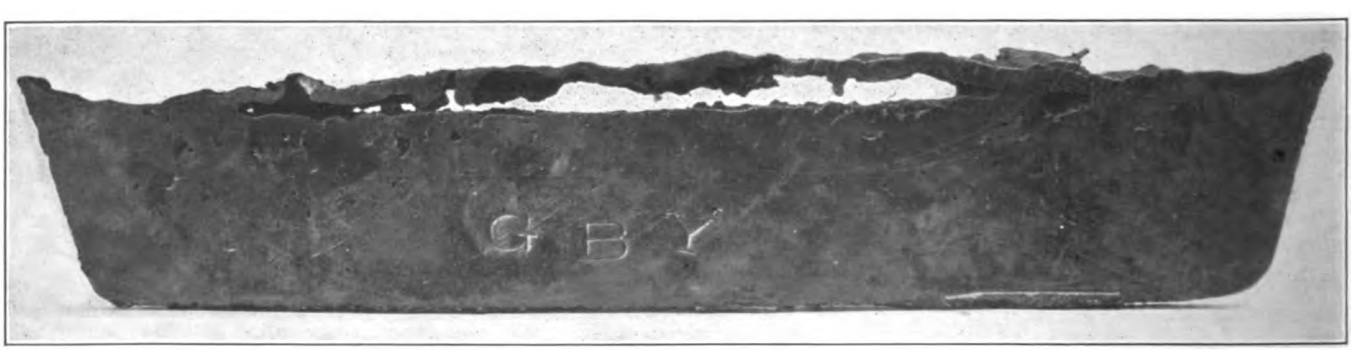

FIG. 4.

FIGS. 1–4.—CROSS-SECTIONS OF TYPICAL PIGS OF BLISTER COPPER FROM VARIOUS SMELTERS.

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partly because the contraction and expansion of the metal of which it is built will cause scales of iron to fall off, and, in addition, whatever grease or oil is used in lubricating the axles is partly distilled off by the heat, so that the car weighs less when coming out of the furnace than when it went in. In one works this loss has been determined by weighing a number of cars, then introducing them into a furnace empty and weighing them again after several hours of exposure to the heat. The loss in weight ran from 0.1 lb. to 1 lb. as a maximum. If this loss in weight of the car had not been determined and allowed for it would have been counted as moisture when the loaded car was reweighed after drying the bars upon it. In one of the most recently constructed drying ovens no car is run into the furnace at all; the bars to be used in the moisture determination are weighed on a scale close to the drying oven, then the bars are lifted and placed upon a conveyor which runs into the furnace under electrical control. After exposure to the heat from the oil, the flame is turned off, the doors of the furnace thrown open, and when the metal has been thus partly cooled, the direction of the chain is reversed, the copper brought outside, and the cooling completed in the open air.

It has been suggested that perhaps copper would be oxidized if exposed to a sufficiently high temperature, under red heat, but whether this be so or not, the increase in weight in the heated copper would inure to the benefit of the producers rather than to that of the refiners, and the same is true of the slight coating of lamp black which is sometimes found on the bars after heating in an oil-burning furnace.

Looking over some recent analyses of various bars of this character, I find that the moisture varies from about 0.02 per cent. to about 0.8 per cent., which is equivalent to 0.4 lb. and 16 lb. respectively per ton of metal.

So far as I know, while there has been a great deal of discussion and consideration of this moisture problem in blister copper, it has not been discussed publicly. I believe that my firm was the first to use mechanical samplers in the Eastern states, in our sampling works built in the early '80s, and naturally we have read with great interest the many technical papers on the sampling of ores and metals, some of which our technical director, Mr. Smoot, and I have discussed in the scientific press, but I do not believe that the question which is the subject of this article has been thus publicly discussed.

The photographs illustrating this condition are a little under half of the actual size of the sections. In the second one will be noted the unfortunate dish-shaped condition, making almost a basin of the bar, which readily holds water on the surface. The first three figures represent typical and normal conditions but the fourth is comparatively unusual, although a few of that kind are found in nearly every shipment.

## Meeting of Engineering Foundation Board

THE Engineering Foundation Board held a regular meeting in Engineering Societies Building, Thursday, Sept. 14, which was largely attended. Minutes of the previous meeting and the treasurer's report were approved.

There was a full discussion of the idea proposed of a moderate financial contribution from the Founder Societies to the Foundation, not only to show a spirit of appreciation toward those who build up the Foundation but also to stimulate interest in its work among the boards of the various societies. The matter was referred to the Founder Societies Joint Finance Committee for favorable consideration and report to the Founder Societies.

A letter was approved to be sent to Senator Joseph E. Ramsdell, asking endorsement of the project for a National Hydraulic Laboratory.

The Foundation approved highly of the project for a National Engineering Museum but felt that to become custodian of the funds of such a museum would be outside the province of Engineering Foundation.

The following advisory committee was appointed in connection the with investigation of arch dams, and $500 was appropriated for preliminary expenses: (1) Arthur P. Davis, director; P. E. Weymouth, chief engineer (alternate), representing U. S. Reclamation Service. (2) A. B. Fletcher, Director of Public Works, Sacramento; W. F. McClure, State Engineer, or Paul Bailey, Deputy Chief Public Works (alternate), representing the State of California. (3) M. M. O'Shaughnessy, City Engineer; R. P. McIntosh, Designing Engineer (alternate), representing San Francisco. (4) H. Hobart Porter, member of Engineering Foundation. (5) Silas H. Woodward, member of Engineering Foundation. (6) Prof. C. Derleth, Jr., University of California. (7) F. A. Noetzli, of Beckman & Linden Engineering Corporation. (8) H. Hawgood, Consulting Engineer, Los Angeles. (9) D. C. Henny, Consulting Engineer, Portland, Oregon.

S. H. Woodard presented in outline a plan for Engineering Foundation to undertake the collection of new information relating to research and development in the various branches of engineering and publication in very condensed form. It was voted to appoint a committee to make a thorough study of Mr. Woodard's proposal. The committee designated is as follows: John H. Barr, chairman; George H. Pegram, A. L. Walker, L. F. Morehouse.

On recommendations of the Executive Committee, it was voted to establish the office of Director of Engineering Foundation, and A. D. Flinn was elected director to give his entire time to the work of Engineering Foundation. The Executive Committee was authorized to make all necessary arrangements with the Executive Board of National Research Council, with which Mr. Flinn is now connected as secretary of its Engineering

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Division, to carry these recommendations into effect. The necessary modification of the by-laws of the United Engineering Society was recommended.

The matter of the study of engineering organizations was laid on the table.

A proposal from Minneapolis to undertake a research in railroad electrification under the auspices of Engineering Foundation was presented and declined.

## James Douglas Gold Medal

THE Directors of the Institute have great pleasure in announcing the establishment of a gold medal to be awarded annually for achievement in non-ferrous metallurgy. The necessary funds have been provided by anonymous donors; the medal has been designed, and the first award and presentation will take place at the annual banquet of the Institute in New York, in February. The endowment is sufficient to provide a gold medal annually in perpetuity. It is in memory of Dr. James Douglas, twice President of the Institute, LL.D. of both Queens and McGill Universities, recipient of the John Fritz gold medal and the gold medal of the Institution of Mining and Metallurgy of London.

### Nominations for the James Douglas Medal

All members of the Institute are invited to send to the Secretary of the Institute, before Nov. 15, the names of persons suitable to receive the James Douglas Gold Medal, accompanied by a brief statement of qualifications. Nominations will be considered by a special committee to be appointed by the president and a report will be made to the Board of Directors, by whom the award will be made.

The rules of award and procedure are in course of preparation and will be announced later.

## Guide Books of the Western United States

THE fifth part of the "Guide Book of the United States," being issued by the U. S. Geological Survey, has just been published. It contains about 250 pages and is copiously illustrated, and the 10 accompanying maps are prepared from Geological Survey sheets with a degree of accuracy probably never before attained in a guide book.

The purpose of these guide books is not as well known as it should be, nor are they as widely used. George Otis Smith, in the preface of this volume, says

> The present stimulus given to travel in the home country will encourage many thousands of Americans to study geography at first hand. To make this study most profitable the traveler needs a handbook that will answer the questions that come to his mind so readily along the way. . . . These books are educational in purpose, but the method adopted is to entertain the traveler by making more interesting what he sees from the car window. . . . One region may be such as to afford a livelihood for only a pastoral people; another may present opportunity for intensive agriculture; still another may contain hidden stores of mineral weatlh that may attract large industrial development; and taken together these varied resources afford the promise of long continued prosperity for this or that state.

One fundamental difference of this guide book and one which will particularly appeal to mining engineers is the fact that the geological features along the way are carefully and accurately explained and illustrated both by diagrams and photographs.

The Geological Survey is doing a great service in compiling these books, of which there are now five, covering the four important transcontinental roads from the Mississippi and the fifth covering the Shasta and Coast Line route in California. No traveler should be without one of these interesting and instructive guide books.

## The Herrin Massacre

THE poet often expresses truths more effectively than it is given to the engineer, economist or even the teacher; thus, one in *Life*, as follows:

### A Verdict

ANGELO, Benjamin, Michael and Paul
Threw down their shovels at Liberty's call;
Their day was too long and their pay was too small,
The job, as it stood, didn't suit them at all,
So they shook it.
Ichabod, deaf to the threats of the mob,
Doggedly said that he needed the job,
And he took it.
Angelo, Benjamin, Michael and Paul
Called him a villain, a slave and a thrall;
Then, as he wouldn't quit work as they willed him,
They killed him.
The Coroner, sitting on Ichabod's case,
Learned that the victim was everything base,
A blackguard, a ruffian, a shame and disgrace,
A traitor for daring to work in the place
Of Angelo, Benjamin, Michael and Paul,
Those heroes who stood with their backs to the wall.
So what in the world could the Coroner do
But find, by the witness of good men and true,
That Angelo, Benjamin, Michael and Paul
Had nothing whatever to do with the brawl;
That Ichabod, friendless, despised and alone,
Had come to his death (which we needn't bemoan)
At the hands of a person, or persons, unknown;
And what was the difference? The fault was his own.
Nobody minded what Ichabod said;
He was dead.

*A. G.*

We have put this under the head of "The Herrin Massacre," but really it is truer of the individual murders that are being committed all the time by members of unionized labor.

**The Black Art.**—It is believed that the origin of the word chemistry was "chemi," meaning "black land," the ancient name of Egypt. It was known as the black art, which may have signified Egyptian art rather than that of a doubtful nature.—Sir Robert A. Hadfield.

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# Gold in Dutch and French Guiana

By GEORGE A. LAIRD

Consulting Engineer, Chappaqua, N. Y.

IF IT IS true that Sir Walter Raleigh lost his head for his failure to find gold in the Guianas, the trumped up charge of "treason" might better have been "contributory negligence." That systematic investigation and development of the gold-bearing areas of both Dutch and French Guiana have not been accomplished is not due so much to the lack of gold as to the geographical, physical and climatic conditions of the two colonies.

The Dutch, as a people, are not prospectors. The French look upon "Cayenne," or French Guiana, as

DJOEKA BOATS USED IN RIVER TRANSPORTATION.

just what it is: a penal colony, which produces a certain amount of balata, gold and essential oils, all of which can be purchased from the natives with far less physical exertion than they can be secured from the "bush" or jungle.

The colonies have had their gold "booms," and during these periods the production has increased to a considerable amount, but the hardships to be endured in reaching the fields, the cost of transporting tools and supplies, the ever-present fevers, the bite of the "57 varieties" of insects and, lastly but not leastly, the abundance of rum in the seaport towns, dampen the ardor of even the strongest; the production of gold is left to the "pork knocker" or illegal gold digger and to the comparatively few producing "mines."

## THE NATIVE INHABITANTS

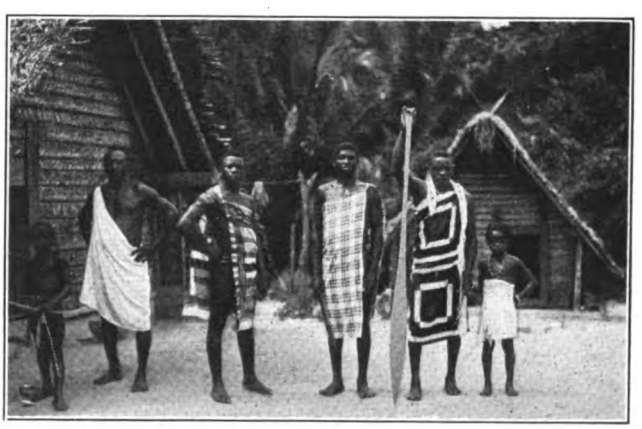
While there is practically no color line or class distinction, there is a decided occupational segregation of the populace. The bushman is either a gold or balata gatherer (pork knocker or balata bleeder) while the "bush nigger," a direct descendant of the African black, confines his exertions to river work. In the river country, the people may be classed under one of the three heads, regardless of the vocation that may be occupying them at the time.

The Bush niggers consist of four tribes, the Djoeka, the Saramacca, the Paramacca (Dutch) and the Boni (French). Various and sundry tribes of Indians, principally Karib and Emerillon, provide pottery, baskets, fruit and game, while West Indians—negroes from the French and Dutch West Indies—and coolies from the East Indies provide the labor, the latter being restricted by law to agricultural pursuits. Social problems arrange themselves in a manner satisfactory to all—at least, to two parties out of every triangle.

## ONLY TWO METALS PRODUCED

There are only two metal products from the colonies: gold and aluminum. Mercury occurs in various localities but has never been produced on a commercial scale. Large areas containing possibly a workable quantity of iron ore were noted, but its value, owing to its location, at the present, is nil, and will be for many years to come.

The most interesting of the gold deposits visited are those of the upper Lawa, approximately 150 miles



DJOEKA BOATMEN.

from the coast line, which occur in both Dutch and French territory. The fields are reached from St. Laurent or Albina, on the Marowijne (Maroni) River, by Djoeka boat; a distance of from two to four weeks, according to the conditions of the river. The river is navigable by a fair-sized boat as far as Apatou Falls, about 70 miles from the sea, and at times by

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power boat to Grant Creek, 20 miles farther south. From this point, rapids and falls make anything but canoes impossible.

The native canoe, 30 to 50 ft. in length, carries a maximum of 1200 kilos and is propelled by poles or paddles by the bush niggers. Black as tar, shining like ebony and veritable giants through the chest and shoulders, these, mere children in intellect, work hour after hour in the blazing sun, 170° to 180° and frequently 100 per cent. humidity, while the passenger gasps for breath and exerts himself or herself in the rapids only to such an extent as "nerves" compel one to grasp the sides of the frail canoe, wondering if it is going up or if it will go backwards and into the rocks. Canoes, built from a single log, do not puncture on the rocks, fill and sink; they split from end to end, depositing load and passengers vertically and immediately.

### Many Alluvial Deposits Discovered

Alluvial deposits have been discovered in many places, practically every creek emptying into the Lawa having at some time been worked. The west fork of the Marowijne, the Tapanahony, has not been credited with any great discoveries, most of the workings being south of the junction. The territory between the two rivers (Tapanahony and Lawa), however, is within the possible gold zone.

### General Geology of Area Visited

The entire area exposed, from the mouth of the Marowijne to the point farthest inland visited, is eruptive or derived directly therefrom; not a single true sedimentary was noted. Granites and greenstones (diorites and diabases) predominate. Huge outcrops of quartz occur and it is frequently stated that these have been directly responsible for the gold of the creek beds and flats. Thorough sampling of many of these failed to provide any evidence that they had even the remotest bearing on them.

Harrison, in his work on British Guiana, attributes the gold to the diabases and in the Lawa territory there can be no doubt of his conclusions. Schists, the direct resultants from diabases, carry appreciable quantities of gold. Large quartz "blowouts" and dikes occurring as secondary material in these schists do not carry gold to the same extent as the ferruginous and the talcose matter making up the mass.

While creek beds have produced the larger part of the product of the colonies, flats and benches, under definite geological conditions, contain appreciable and workable qualities of alluvial gold—all the direct result of rock decomposition and (gold) sedimentation. The gravels consist of blue, white and pink secondary quartz, which, occurring as stringers, veins and blowouts, has been freed from the schist by weathering and decomposition. The bed rock consists of clay, directly overlying the schist, which may show much or little alteration. On the flats and benches, particularly those which have been cleared, the actual process of weathering and sedimentation is visible.

In one area, 2.5 gm. of gold were picked up after a hard rain; a later rain provided practically the same amount. This area contained no overburden and no quartz other than that in stringers varying in width from a knife blade to perhaps 3 in., and, although thoroughly sampled, no quartz yielded more than 20 cents per ton in value by assay; the mass, quartz, clay and ferruginous material, showing from 66 cents to $3.42 per ton.

Headquarters, Mines d'Or, Degrad Pointu.

The gold occurs, in order of values: in the overburden—loam, earthy clay, laterite; in gravel consisting of angular quartz and iron-stained diabasic material; in the bed rock or clay which generally overlies the firmer and less altered schist. The overburden contains only fine gold in amounts varying from a few cents per yard to one dollar, the latter being the exception. The gravel contains from "colors" to well up in the dollars per yard, the gold generally being coarser than that in the overburden and frequently being in nuggets of half an ounce or more.

The bed-rock clay, from 1 to 10 in. deep, is generally slightly richer than the overlying gravels. In some places there are several layers of gravel separated by clay or talcose material; when this occurs, the deeper stratum is invariably composed of more angular material and relatively larger quantities of gold. The upper layers have been subjected to more abrasive action and, while rich pockets occur, are rarely considered as being workable in themselves. Two occurrences of workable schist were noted, sluicing having proved profitable to some depth. In one instance the schist was badly broken; in the other, it was badly altered but did not show the usual amount of sedimentation due to weathering.

### No Gold Found in Quartz

In literally hundreds of specimens of quartz examined with a hand glass, not a single one showed free gold. The sluices frequently yield particles of very rich quartz, blue, white and pink, yet even in the districts from which this quartz was noted no results higher than 60 cents per ton could be secured by the most

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careful search and sampling. The dense tropical vegetation makes it necessary for the prospector to confine his labors to the creek channels; with no knowledge of the probable origin of the gold, this has been confined to that territory nearest to the navigable streams and, as all supplies must be taken in from the river and as the trip to the point of the river bank at which operations begin is of no small moment itself, the back country is practically unprospected. In one area of approximately 60 square miles, four different schist zones were mapped. When crossed by creeks or along the flats and benches where sedimentation could take place, every point investigated showed gold in appreciable quantities.

### Crude Working and Sluicing Methods

On one flat, near the top of one of the highest peaks in the district, 4 in. of gravel containing "colors" underlay 12 ft. of aluminous clay and laterite, showing that the process of alteration and enrichment was not confined to the lower areas alone. Much of the surface is covered with oolitic iron, frequently several feet thick, occasionally 6 to 8 ft. With this occurs small amounts of high-grade bauxite, but none of the latter in commercial quantities.

Sluicing in Upper Lawa, Dutch Guiana

Working methods are exceedingly crude. Sluices are set at a convenient angle, regardless of their efficiency. All work is done by hand. In one particular area, gravel, being washed for the eighth time, was profitable; in another, gravel taken from the tails pile actually contained more gold per yard than the feed, because much of the earth had been removed, and the gold left with the heavier sand and gravel. Old tailings yielded clean gold, amalgam and perfectly clean mercury; yet the work was proving satisfactory to the operators, because the recovery was profitable.

The territory presents great possibilities, but not to the local prospector. Only systematic work, largely geological, can open up the country. Failure after failure has been recorded in the Guianas, the causes being largely misguided methods on the part of the larger operators, lack of funds on the part of the smaller operators, and lack of even the necessities of life on the part of the pork knockers.

### Causes of Failure

Once away from the lowlands of the coastal region, the climate is far from unbearable, fever is largely avoidable and the pestiferous insects can be provided against or endured. There are more graves of men who have succumbed to alcohol than to fever, and more money has been expended for "booze" than for actual operations by the representatives of the various companies that have gone down in failure.

The territory provides a wonderful field for the fake promoter, who has already done more than his share to give the industry a bad name in the colonies. It also provides a field of unusual promise to the men who play the game, who can stand the gaff of climate and conditions and who have the stamina to stay with it.

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## Russia Reopened for Mining*

By Leslie Urquhart

THE agreement which has been come to between the Soviet representatives and the Russo-Asiatic Cons. has been hailed all over the trading world as an event of decisive significance. In this view I entirely concur. The turning-point in the development of that new Russia which is destined to play as commanding a part in the international commerce of the next half century as the Western States of America have played in the past half century will be dated, I believe, by economists and historians as well as by current opinion from the signing and ratification of this most auspicious compact.

They were admirable bargainers, and the tension at times was severe. But in the end we hammered out an agreement which is wholly for the good of Russia, which gives me everything I need in the way of assistance, safeguards, and guarantees, which is acceptable to the rulers of the country, and which, with good faith on both sides, ought to be, and in my judgment will be, a powerful instrument of Russia's industrial revival.

### A Huge Organization

I do not know whether it is understood in Great Britain that the Russo-Asiatic Consolidated, whose interests I have the honor to represent, is the biggest industrial organization in Russia, and one of the biggest in the world. It practically controls Russia's nonferrous metal industry, nearly 70 per cent. of her copper production, all of her zinc and lead output, and over 20 per cent. of her gold production.

It has large iron and steel works, numerous coal mines, over 300 miles of railway, and more than 2½ million acres of land. When it was fully at work it employed over 45,000 workmen and supported a

* Reprinted from *London Times*, Sept. 17, 1922.

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population of over 250,000, whom it housed, schooled and supplied with hospitals, theatres, and many other of the conveniences and amenities of civilization. Our claims against the Soviet Government for confiscation and disturbance—claims now happily adjusted by the Agreement—came to £56,000,000. That is to say, they amounted to nearly a third of all the claims of all British traders and companies in Russia.

The size and the importance of this great undertaking and the fact that it is engaged on those basic industries which (next to agriculture) lie at the root of national prosperity, undoubtedly give it a position of some privilege. I mean it was natural that the Soviet rulers, when they had decided to come to terms with foreign interests in Russia, should begin with us. Moreover, as a British enterprise it was also exceptionally placed, because I do not hesitate to say that while the present rulers of Russia are not enamored of any foreign nation they are less disenchanted with us than with any other people; and they would genuinely prefer that the external capital which they now recognize as essential to their recovery should be furnished by British investors rather than from any other source. They know that British capital is non-political and non-interfering, confines itself to business operations, and on the whole aims at giving a square deal all around.

### Very Favorable Terms

For these reasons, among others, the Russo-Asiatic Consolidated has succeeded in securing terms from the Soviet Government which are exceptionally favorable—exceptionally favorable, I mean, for a private company acting and negotiating without the support, financial or diplomatic, of its own government. We happened to have the monetary resources that enabled us to meet Mr. Krassin and his colleagues half-way. Other British enterprises in Russia may not be in the same happy position. In point of fact, very few of them are. One would not be far wrong in taking it as a starting point that practically all British companies in Russia, like the Russian Government itself, are at the end of their tether, and must be assisted from without if they are to resume business.

Where is that assistance to come from? Where can it come from if not from the British Government? I am going to make two statements on this subject which may sound surprising, but which, I am convinced, are perfectly true. The first is that there is no British concern in Russia of any standing which cannot obtain from the Soviet rulers as good terms as, or even better terms than, the Russo-Asiatic Consolidated has received, if only the British Government will exert itself on its behalf.

The second is that at the outside an advance of not more than £15,000,000 will be all that is needed to restore all British undertaking in Russia to full pre-war activities, that on this advance the British Treasury, if it handles the business properly, ought not to lose a single penny, and that an Anglo-Russian Trade on a scale hitherto unknown will infallibly result from prompt and provident action.

To any British companies that are thinking of following in the footsteps of the Russo-Asiatic Consolidated I would suggest first, that they need not worry overmuch about Communism as a political system. Let them get in touch with the Department of Overseas Trade and with the Soviet rulers and see, as business men who are not concerned with politics, what sort of a bargain they can strike. I do not think that either in London or in Moscow the results will disappoint them.

Secondly, if they are going to do anything at all, I would advise them to do it quickly. The collapse of Russia was sudden and terrible; her recovery may equally amaze the world by its rapidity. Russia is inexhaustible and indestructible, and the signs are not lacking that already, even beneath the accumulated miseries of the past five years, her inveterate resilient impulse, her tremendous recuperative power, is beginning to gather strength and confidence.

Do people realize what it means that Russia should again be self-supporting? The harvest this year, for the first time since the Revolution, will be sufficient to supply her domestic needs. A year or two hence we may again see her exporting agricultural produce on something not so very much below the old pre-war scale; and Russia's export of wheat used to be, and will be again, the first of all factors in stabilizing prices and making it possible for the world to live within its income.

But there is more in it than that. The peasant—and the peasant, remember, is Russia—has had his standard of life, his tastes, and habits, and requirements very greatly enlarged since 1914. With the incentive to produce again restored to him, as it has been by the "new economic policy," he will become an immense purchaser of machinery, clothing, household utensils, and the substantial things that make for the comfort and embellishment of a home. In other words, he will need, and in unprecedented quantities, the goods that British factories are peculiarly qualified to supply.

It seems to me we have here one of the greatest opportunities that has ever presented itself in our commercial history. I cannot think we shall let it slip by. That we have enough of business enterprise to seize it and make the most of it is beyond any kind of question. But business enterprise, in the present abnormal circumstances of Russia, is not in itself sufficient. It must be backed up by statesmanship and collective governmental action. Whether the British Government has always been wise in what it has done or has left undone in regard to Russia, one need not now inquire. But I am positive that the moment has now come when by a wise use of credits it can do an unparalleled service to Britain, to Russia,' and to Anglo-Russian trade.

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# What is the Matter with Modern Galvanizing?

By J. A. SINGMASTER* AND G. F. HALFACRE†

Of New Jersey Zinc Co.

A REPORT that it did not pay to use present-day galvanized iron on account of the short life of the material, accompanied by proofs of the statement in the form of a tabulated history of the first costs of various kinds of building materials and their maintenance expense, started an investigation of modern galvanized products.

At the very outset it was apparent that our experience with galvanized products was by no means unique. Correspondence with the State Agricultural Departments, the Agricultural Experiment Stations, the County Agents and State Granges all over the United States brought a mass of complaint on this same score. Visits to large buyers of galvanized sheet and wire revealed the same condition coupled with an ever-increasing use of substitutes for galvanized iron. We believe, therefore, that the title of this article is fully warranted by the experience of the consuming public.

A study of the proceedings of the various societies having to do with the testing and use of sheet iron and steel products revealed a tremendous amount of work on the life of the base metal itself. Great stress was laid on differences in life of various types of iron and steel, the difference amounting at best to months rather than years. Very little recent attention has been paid to a study of the life of the zinc coating and the causes of its present-day lack of durability. There have been some real exposure studies published, however, which show that the weight of the zinc coating determines the protection afforded by the galvanizing, which is of far greater influence on the life than the base-metal composition.

An interesting paper was published by the *Phillipine Journal of Science* in 1916, entitled: "Galvanized Roofing in the Phillipines," a contribution from the Bureau of Science of the Phillipine Island Government. The author, Mr. Arguelles, found on 18 old galvanized sheets, after from 30 to 35 years' exposure, from 2.3 to 4.1 oz. of zinc per sq. ft. of sheet and sums up the study by saying:

> Of the various factors influencing the durability of galvanized iron which have been studied with a view towards accounting for the difference in behavior of old and modern sheet, it appears evident that the greater weight of zinc per unit of area on the former accounts for the greater durability.

The U. S. Department of Agriculture, speaking on the subject of galvanized road culverts, says:

> Having in mind the sort of material now in general use, we may say that, roughly speaking, the duration of the spelter coating will be about three-quarters of the life of the culvert. It is the present practice of the Bureau of Public Roads and of many of the state highway departments to specify that culvert sheets shall carry at least 2 oz. per sq. ft.

Walker, in 1909, after investigating the general complaint on the durability of farm fencing is quoted as follows:

> In every instance where a very durable fence was found, the zinc coating proved to be relatively very thick; while on the other hand the fence wires which showed marked corrosion in one or two years proved to have almost no zinc on the iron, the zinc color being due to a layer of alloy alone. Thus a barbed wire fence which was made from unwiped telegraph wire carried 3.9 per cent. of zinc and after four years shows corrosion only on the barbs, which were made from ordinary closely wiped wire, while another sample which carried 1.4 per cent. of zinc was badly rusted in three years; a third fence in two years exposure had lost all of its coating and was covered with rust. . . . That in the very important matter of fencing wire, while the purity of the iron used is of consequence, a more immediate necessity is a heavier coating of zinc on the wire.

## Weight and Purity of Zinc Coating Important in Galvanizing

The statement regarding the effect of weight of the zinc coating on the life of galvanized material is further substantiated by the experience of large companies, that use considerable quantities of galvanized products and which have been driven to specifications in order that they may secure products with a satisfactory life. The list of these buyers includes not only prominent industrial and public service concerns but our own and foreign governments as well. The large manufacturers, it is true, furnish on demand material galvanized to given weights of coating and charge extra prices for this better material. The average user, however, who has no specifications or who buys in small quantities on the open market, is not sufficiently posted to be able to avail himself of this protection and consequently receives material that at times contains practically no zinc.

We have carefully examined about 50 samples of galvanized sheets of recent manufacture, obtained from 36 manufacturers in the United States, and find that the weight of coating on these sheets varies from 0.62 to 1.9 oz. per sq. ft. with but five of the samples in

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† Investigator, Research Division, Palmerton, Pa.

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excess of 1½ oz. per sq. ft. Compare these weights with the minimum weight of 2 oz. per sq. ft. of sheet required by the majority of buyers of sheet under specification. Is it any wonder that galvanized iron, which according to Webster is "iron coated with zinc to protect it from rust," fails prematurely and brings all galvanizing into disrepute?

The situation as regards wire is still worse, and the failure of this product is the subject of unanimous complaint from all the agricultural interests. We have examined samples of 14-gage wire which carried about one ounce per mile of wire. Such wire rusts in several days exposure. A number of samples of commercial galvanized wire carried from 0.006 oz. to 0.30 oz. per sq. ft. of surface, whereas the wire bought under the standard public utility specification is specified to withstand four one-minute dips in a standard copper-sulfate solution which our experience shows to be equivalent to a minimum of 0.9 oz. per sq. ft. of surface.

The same situation exists regarding galvanized nails. The roofing industry in general (particularly the prepared roofing and shingle industries) has been driven in self-defense to stringent specifications on the weight of coating on the nails used to fasten its products, since the life of such roofs was considerably shortened by the failure of the nails before the failure of the roofing material. Many companies now furnish the necessary nails, properly coated, with their products in order to protect the reputation of their roofing materials.

### Waste of Materials Caused by Insufficient Coating

You may ask why such a state of affairs exists. The answer lies partly in efforts on the part of manufacturers to reduce their own expenses by skimping in the amount of zinc on the finished product. Unscrupulous manufacturers have undoubtedly set the pace in this respect and by wiping and squeezing have reduced the amount of zinc remaining on the iron and steel base to a minimum.

When an iron article is galvanized, the zinc adhering to the iron is in two forms. Next to the iron is a zinc-iron alloy which, while it will resist atmospheric corrosion and consequent rusting to a certain degree, is by no means a long-lived protection against rusting. The main protection comes from the pure spelter or zinc coating, which in proper galvanizing covers the iron-zinc alloy and forms the true protection of the article. In some cases there is no spelter, or zinc as such, left on the material which it is supposed to protect, after this wiping or squeezing; nothing remains but the thin layer of alloy which should hold the spelter to the iron, and cannot be relied on for protection against atmospheric corrosion and rusting for any appreciable time.

Another reason for reducing the weight of the coating is to enable the severe bending and forming operations, to which some galvanized iron is subjected, to take place without the flaking of the coat. The iron-zinc alloy is quite brittle and under the microscope can be seen to break in minute cracks over the bend, cracks which are invisible to the naked eye; whereas the true zinc or spelter layer, especially if impure metal is used, will crack and come off in relatively large flakes, easily visible to the naked eye. This has led to the so-called tight coated sheet which carries the smallest quantity of zinc that it is commercially possible to leave on the finished product. The success of this thin coating in withstanding bending and subsequent corrosion is more apparent than real. The reader's attention is directed to the life of the modern galvanized gutter or leader pipes which come under his daily observation, as proof of the statement. Look particularly where the material is lock seamed or beaded.

There is evidently a huge annual waste due to materials which rust and are destroyed prematurely by the entire absence of a real zinc coating or the failure of one of insufficient thickness. This waste is well recognized by the consuming public and has resulted in the trial and use of numerous substitutes. A few large and well-informed consumers have applied the remedy of specifications. In several states efforts have been made to secure laws that will require the branding of galvanized products with the weight of the zinc coating applied. Such action has already taken place in the case of the pure food laws and in the branding of paints. We believe it is to the mutual interests of the iron and zinc industries to coöperate in measures for the return of galvanizing to the heavy coated work and the re-establishment of the reputation of this material, rather than to surrender the field to substitute materials which in many cases contain neither metal.

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## The Story of Steel

A SIX-REEL motion picture film, "The Story of Steel," has been produced under the auspices of the U. S. Bureau of Mines and the U. S. Department of Commerce in coöperation with the United States Steel Corporation. The film depicts the various processes from the mining of the iron ore to the finished steel product, passing through the transportation period, blast-furnace operations, and the making of steel by the Bessemer, open-hearth and electric processes. The manufacture of rails, plates, shapes, axles, rods, wire products, pipe, tin plate and other products of steel are told in a graphic way, and the many welfare and social activities carried on by the United States Steel Corporation for the benefit of its employees are shown.

The film will be loaned without cost to dependable persons for educational purposes. Application should be made to the U. S. Department of Commerce, Washington, D. C.

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# Sintering Iron-bearing Materials

By R. L. LLOYD

Vice-president, Dwight & Lloyd Sintering Co., New York

UNLIKE the development of sintering lead, copper and zinc ores, the sintering of fine irony material had its birth, not as a result of gradual growth along lines aimed at the production of sintered and agglomerated product, but because the success of the sintering operation in other lines had been brought to the attention of the ironmasters, who were immediately attracted by the prospect of being able to convert their own fines into a similar product.

The abundance of iron ores in the United States and their comparative cheapness had led iron men into the habit of not paying particular attention to the fine material blown out of their blast furnaces. Hundreds of thousands of tons had been stacked up and used only during times of shortage of ore and then usually without any preliminary preparation, though many attempts had been made to briquette it. Briquettes proved good material, but the operation of briquetting was too expensive when applied to iron-ore fines.

The development of the iron-ore blast furnace in the United States tended toward large units, high columns and heavy blast pressure, and this tendency is still peculiar to this country, whereas in the other countries the tendency has been to smaller units, lower columns and lower blasts.

The high blast pressures and swift driving of the American blast furnace tend, of course, to produce more flue dust than European practice, and this production of flue dust was augmented when large quantities of soft ore, of which the Mesabi is typical, came on to the market. These ores are desirable chemically but physically they are soft, friable and fine, and when they are used in the iron blast furnace the flue dust production is increased. The necessity of rehandling the flue dust lead to briquetting on an extensive scale. The binders used were either chemical or mechanical, and in one system the briquettes were kiln fired in very high temperatures. Rotary kilns, coal or oil fired, were used extensively, and gave a product of hard and more or less nodulized material, but at considerable cost.

This was the situation in regard to iron flue dust when the late James Gayley and his associates became interested in the idea of sintering the iron blast-furnace flue dusts under their own fuel (included coke dust) of which they carried between 15 and 30 per cent.

The preliminary experiments produced a coke-like sinter, more or less friable when considered as a whole, and breaking up more or less readily into pea or hazel-nut sizes, but without the formation of any real dusty particles. Even the smallest particles were granular. The experimenters, being used to the massive type of sinter ordinarily produced in lead and copper work, considered these preliminary results unsatisfactory, but the ironmasters welcomed even the pea or hazel-nut sizes as much better than anything previously produced; as a result experiments on a larger scale were carried out at Birdsboro, Pa., and a standard Dwight & Lloyd unit such as had been used for lead work was installed. The results from the beginning were satisfactory, and showed better work than could be done on laboratory apparatus.

The sinter product of the Birdsboro plant, while still not so massive as the lead and copper sinters, was considerably coarser than the product of the laboratory experiments, and was thoroughly acceptable material for the iron blast furnaces. Many of the conditions necessary to produce good sinter were worked out at the Birdsboro plant, and as a result of the work done there, other sintering plants were installed, until at present practically all of the large iron companies are sintering their flue dust, either alone or in connection with ores and concentrates, and in Europe, especially in Germany and France, iron-bearing materials of several kinds are being prepared for the blast furnace on a very large scale by Dwight & Lloyd methods.

## Iron-bearing Materials Adaptable to Sintering

In general, all fine iron-bearing materials should be sintered before going to the blast furnace, because it is wasteful to put anything into a blast furnace, blow it out again and re-treat it before putting it back into the furnace. Iron-bearing materials to be sintered are classed according to their behavior while undergoing the sintering operation, and these classes, in order of their present importance in the United States, are as follows:

1. Blast-furnace flue dust.
2. Pyrites cinder (blue billy).
3. Iron concentrates (magnetic or non-magnetic) and iron sands.
4. Non-hydrated fine oxide ores.
5. Fine hydrated oxides.
6. Mill scale and oxide byproducts.

Blast-furnace flue dust sinters readily, but its behavior on the machine and the nature of the product from it depend largely on its carbon (coke) content.

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When the coke content is very high, the internal shrinkage of the mass is great and the product is finer in size than when the flue dust contains less carbon, also the bed becomes extremely hot and the operation is delayed; a machine working on such a high-carbon dust will have only from one-third to one-half the capacity that it would have on an ore or mixture containing just enough carbon to perform the sintering operation.

As the fuel decreases in the flue dust, the operation becomes swifter and the product more massive, and at the point where carbon amounts to about only 8 per cent. of the total weight of the material to be treated, whether it be flue dust alone or a mixture of flue dust and other materials not containing carbon, the machine attains its greatest capacity and the product becomes stronger and more massive when considered as a whole.

Pyrites cinder (blue billy) must have added to it either carbon, usually coke, or a carbon-bearing iron material (flue dust) in order to furnish heat for the sintering operation. Where coke or other carbonaceous material only is used, the resultant sinter is very like the sinters produced from high-carbon flue dust, and for the same reason: the excessive internal shrinkage of the mass while being sintered. Nevertheless, the product is a good product and entirely acceptable to the ironmasters.

The cause for the internal shrinkage in the case of the high-carbon flue dusts is the burning out of the large quantity of coke which they contain, but the cause of the internal shrinkage in the case of the blue billies, unless they have been freshly prepared, is the fact that blue billies which have stood for a long time are partly or completely hydrated, and the driving off of the water results in shrinkage; the less hydration, the less internal shrinkage and the more massive the product.

Iron concentrates, magnetic or non-magnetic, and iron sands, sinter very readily and give a massive, cellular product with comparatively little internal shrinkage. On these materials less fuel may be used than in sintering blue billies. The minimum fuel which has given good results has been used on magnetic concentrates, and good acceptable sinter has been made with this material when mixed with only 3 per cent. of its weight of carbon in the form of coke fines.

### Mixtures May Be Sintered

Fine hydrated oxide ores act in almost the same way as blue billy. Non-hydrated fine iron ores sinter readily; usually not quite so fast as concentrates nor with quite so low a fuel ratio, but making a product similar to that made from concentrates.

Mill scale and oxidized byproducts are usually mixed with other materials to be sintered. They are seldom in quantity sufficient to be treated by themselves, but if treated by themselves behave like magnetic concentrates.

All these materials may be mixed one with the other in any proportions, and the mixture will act on the machine like its nearest type of ore, concentrate or blue billy. When mixing such materials, flue dust is used in the proportion that will give the minimum amount of carbon necessary to carry out the operation, but this minimum amount must be determined for each mixture. In the case of flue dust there is no choice; for average ores and blue billies, 8 per cent. carbon will give the best results. For concentrates, according to whether they are magnetic or non-magnetic, the fuel ratio will range from 8 to 3 per cent.

### Physical and Chemical Properties of Sinter

The sinter produced from any of these materials or mixtures is chemically the same, and is physically the same as to interior structure. High-carbon flue dust, hydrated oxides and blue billies, which have the greatest internal shrinkage while being sintered, break up into smaller pieces than the sinter produced from concentrates and non-hydrated ores, and the mixture of a flue dust and a non-hydrated ore will behave precisely as a non-hydrated ore which has been mixed with carbon in the proper proportion. In using the word "massive," reference is not to the interior structure of the sinter, but to the non-tendency to break into small pieces. The interior structure of the sinter is practically the same for small and large sizes.

The internal structure of the sinter is perhaps its most important feature. Well-made sinter produced with the proper amount of carbon is a coke-like mass, porous throughout. The smallest grain of such sinter when examined under the microscope shows a spongy porous structure. If too much coke is used, the porosity of the sinter will be reduced, and if too little coke is used, the material will be incompletely sintered and become very friable and pulverulent. Chemically, a sinter made by this method approximates the formula $Fe_3O_4$.

Because of the fact that the material has an approximate analysis of $Fe_3O_4$ and is magnetic, the iron furnace men were at first disinclined to use it, because of the well-known difficulties in reducing magnetite having a similar analysis. Magnetite reduces slowly because it is massively non-cellular and therefore presents per unit of mass comparatively small surfaces to the action of reducing gases in the blast furnace; sinter is the exact opposite physically, presenting per unit of mass very large surfaces to the action of reducing gases. It not only reduces more quickly than ordinary ores, but with less coke, as it should do, on account of its chemical characteristic. Addition of sinter to the blast-furnace burden has invariably resulted in increased furnace speed and decreased coke consumption.

As to the amount of sinter that might be used on a charge, a considerable discussion arose among the men who were using it. It has been shown that with sinter up to 80 per cent. of the charge there has been no trouble, and the furnaces have speeded up in production and lowered their coke as the amount of sinter increased in

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the burden. Some plants have used as much as 100 per cent. sinter for considerable periods with entire success. In Germany during the war 100 per cent. sinter was used, and I am informed that no attention was paid to the amount of sinter going on the furnace, except to proportion the coke accordingly.

Sinter approximating the formula $Fe_3O_4$ contains more iron per unit, of course, than the material from which it is made ($Fe_2O_3$), except in the case of magnetic concentrates when it has the same approximate analysis as the original material. With regard to the other constituents of the ore from which sinter is made, the silica, alumina and earthy bases will be greater in the product than in the original ore, according to the loss of weight brought about by the sintering operation. Phosphorus will also be higher, for the same reason, as it is not eliminated in sintering, but neither phosphorus, silica, alumina nor the earthy bases will change their proportionate relations to the iron content. The sulfur, however, is largely eliminated, and in ores carrying only 0.2 or 0.3 per cent. of sulfur originally, the sulfur in the sinter will be in the hundredths.

Ores and blue billies carrying from 2.5 to 4 per cent. sulfur will produce sinters carrying only 0.2 per cent. sulfur, or less, so that from comparatively high-sulfur blue billies or ores, a sinter can be made that will fall well within the Bessemer limit for sulfur. With the pure ores of the United States this reduction in sulfur means much, but with the low-grade ores of England and the Continent it does not mean so much, because in English and Continental practice so much slag is made per ton of iron that it is possible to send off with the slag much more sulfur than can be done in the United States for equivalent quantities of iron.

In the United States sintering costs for iron-bearing materials are usually quoted as per long ton of sintered product, and at this moment the figure varies between 60 cents and $1.25, according to the design and tonnage of the plant, the nature of the material to be sintered, the cost of labor and power and the method of cost keeping. This latter varies very widely in different plants working the same tonnages and classes of materials, and it is very difficult to compare the costs of any two plants without a close study of the items which go into their several cost statements.

## Mexican Oil Expectations*

THE first era of the Mexican oil industry is drawing to a close. The production of petroleum in Mexico dates from about the year 1901, but it was not until 1911 that the yield assumed such proportions that a surplus over domestic consumption was available for export. Only during the past few years has Mexican oil become a real factor in the world's markets, and an important source of revenue to the government and people of Mexico.

Producing operations up to the present time have been largely confined to lands owned in fee or leased from individuals in two districts lying within the area bounded on the north by the Tamesi River; the Tuxpam River on the south; the Gulf of Mexico on the east; and on the west by an irregular line extending from the mouth of the Vinasco River through the Otontepec Mountains to the Panuco River, thence to the Tamesi. Although this area contains something like 2,470,000 acres, production has been found concentrated only in two producing districts—the Panuco field, producing very heavy, viscous oil, and the Southern field, producing a somewhat lighter gravity oil.

Explorations of the past 20 years within this vast area have developed only the two producing districts named, which together contain approximately 25,000 acres, or about 1 per cent. of the area explored. It is estimated that the investment in the exploration and exploitation of Mexican oil has been not less than one billion pesos, or $500,000,000 United States currency. These figures do not take into consideration the cost of tanker fleets and foreign storage, manufacturing plants and other facilities created for the handling of Mexican oil. This investment has resulted in the production of approximately 700,000,000 bbl. of oil in the past 20 years, over 500,000,000 bbl. of which were produced in the last five years. During this same period, the Mexican Government has received by way of direct taxes from the oil producers approximately $75,000,000 of which $68,500,000 have been collected during the past five years; $31,000,000 in 1921.

### Importance of Oil Industry to Mexico

These taxes represent actual money paid to the Mexican Government, but other far greater benefits have accrued to the Mexican people through the great expenditures for wages, materials, supplies and transportation, as well as large sums paid to the land owners as rentals and royalties. Up to the present, the industry has been conducted by foreign companies and by methods similar to those prevailing in the United States, whereby the owner of the surface received about 10 per cent. of the production. No better illustration of the importance of the oil industry in Mexico can be given than that offered by the figures for 1921 of the United States Department of Commerce, showing total exports of petroleum products to the United States to the value of $77,389,637, as compared with a total of all other merchandise to a value of $41,705,896. The volume of oil shipped to the United States during 1921 was 128,780,000 bbl. and the taxes paid thereon represented 46 per cent. of the Department of Commerce valuation, less taxes. It is evident that the oil industry has been of the greatest importance to Mexico. What is the position of that industry today?

* Reprinted from *The Lamp* (August, 1922) published by the Standard Oil Co. (N. J.).

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In both the producing fields above mentioned, exhaustion of oil resources has reached such a point that the exploitation of at least two-thirds of the estimated 25,000 acres of the producing area has been abandoned. In the Panuco, or heavy oil field, where once 125,000 bbl. per day were produced, the average is now only about 100,000. In the Southern field, Mexico at one time produced as much as 500,000 bbl. of light crude oil in a day. Within the last few weeks, this has been reduced to less than 300,000 and is still declining rapidly.

### Mexican Investments Never to be Recovered

Under existing conditions only a part of the huge investment which the operating companies as a whole have made in Mexico will ever be returned to them. In this connection, it must always be remembered that apparent profits from the operation of oil wells or other mineral deposits do not and cannot become actual profits until the sums invested in the enterprise have been completely amortized. It is safe to assert that few, if any, of the existing oil companies have been reimbursed for their original investment up through the present time, and that collectively they now face a loss of not less than one-half of the original investment. The story of the insolvent companies and of the great losses suffered by many others of the producing companies in connection with their Mexican oil investments as evidenced by the annual reports of some companies and the court records in regard to others, tells something of the situation in which the companies find themselves today. It is no exaggeration to say that if the companies had foreseen the conditions which now exist they would never have invested the capital which has gone into the development of the Mexican petroleum industry . . . By the middle of 1922, the Mexican petroleum industry had reached a crisis in its career, and the outlook for the future is full of uncertainties. Of the several big Southern District fields the only territories not reduced to stripping fields by salt water invasion were part of Cerro Azul and Tierra Blanca, Chapapote Nunez and part of Cerro Viejo. The new Tierra Blanca Chapapote development of the Huasteca lends promise of a productive unit there, but with this exception, the Southern District gusher production is gone. Under the most favorable circumstances the proved portion of the Southern District Belt does not provide any foundation for another decade of operations for the oil companies generally.

In the Northern District fields the situation is somewhat similar. The Topila field has been reduced entirely to stripping and Panuco field, although producing about 100,000 bbl. daily, has shown salt water all through the field and most wells are producing with pinched valves. The discovery of the new area in Palangana, between Panuco and Topila, toward the close of 1921, together with the generally irregular and spotted nature of the productive conditions in this area, suggests that similar new developments may be hoped for during a period of several years in the broad Panuco-Topila area of structural disturbance. Drilling activities in the Panuco-Topila area increased markedly during 1921, and prospects for 1922 point to a still greater manifestation of interest in the properties surrounding the proved production on all sides . . .

The present situation is critical because the progressive exhaustion of the production has not been compensated by the exploration of new territory and the discovery and opening up of new fields. The oil industry will have no future in Mexico unless an intensive effort to find new fields of production be undertaken and successfully prosecuted. The areas to be explored are more remote from the ports of shipment than those now producing, and the necessary development work can be carried through only by expenditure of a vast amount of new capital.

It is essential to the permanency of the petroleum industry, as known fields begin to be exhausted, that reserves for the future be discovered by the extension of operations to other prospective areas.

The conditions and circumstances which have interfered with the carrying out of this established practice in Mexico, including those conditions which have prevailed to deprive capital of the fundamental and essential insurance which it must have as to its investments and the conduct of its operations, have largely grown out of the unsettled political situation that has prevailed in Mexico for the greater part of the last 12 years.

### Future of the Industry

Unfortunately, both for the welfare of Mexico and of the petroleum industry, the consequences of this situation must be suffered now and in the months near at hand. The future of the oil industry in Mexico rests primarily in the hands of the government.

Assuming that the undeveloped area of Mexico contains enough of promise to justify further capital investment, such effort can only be undertaken when the Mexican Government shall find ways and means of extending to the oil industry the cordial encouragement and coöperation usual in other countries. It is our hope that the present Mexican administration, which has already gone far toward solving its financial difficulties, will soon make it possible for foreign capital to safely and wisely participate in the development of the natural resources of that country.

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**Boron as a Steel Alloy.**—Experimental work performed by the U. S. Bureau of Mines indicates that the use of boron as an alloy confers marked hardness on steel. If the other physical properties of the boron steels are good enough to be applicable to commercial use, their remarkable plasticity at temperatures below the melting points of ordinary steels might make it possible to utilize this characterisitc.

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# Taking Cores in Rotary Drilling Operations

By JOHN R. SUMAN

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DURING the past few years the taking of cores in drilling with rotary equipment has been perfected to a remarkable degree in the Gulf Coast fields of Texas and Louisiana. Taking of cores is becoming quite a common thing, especially in the newer fields, and drillers are becoming expert in this work.

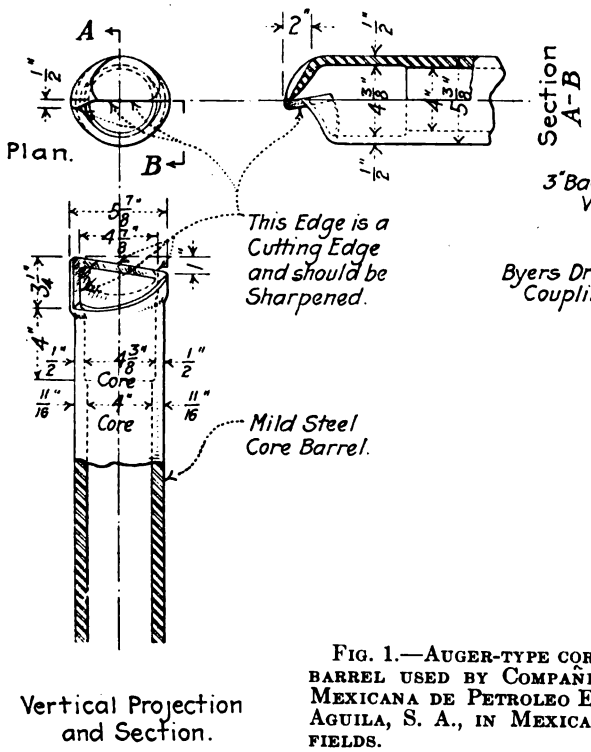


FIG. 1.—AUGER-TYPE CORE BARREL USED BY COMPAÑIA MEXICANA DE PETROLEO EL AGUILA, S. A., IN MEXICAN FIELDS.

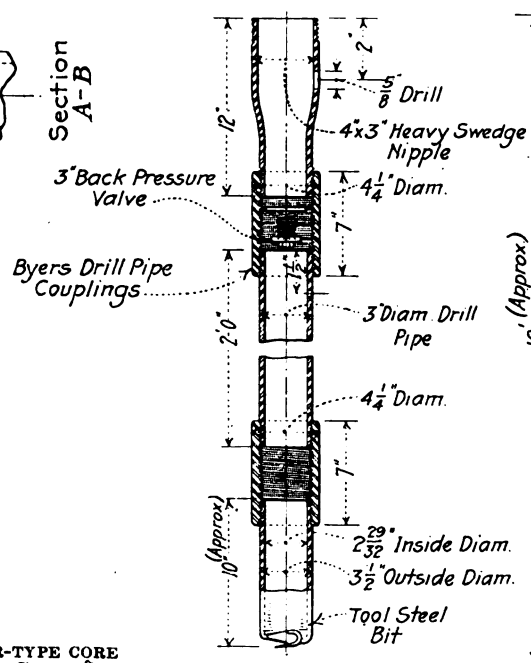


FIG. 2.—AUGER-TYPE CORE BARREL FOR TAKING SAMPLES OF SOFT FORMATIONS.

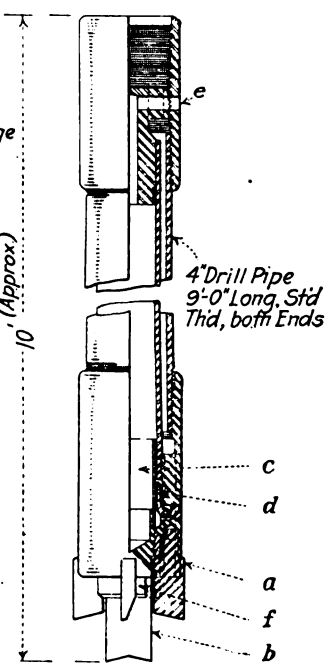


FIG. 3.—REED AND HEPLER CORING TOOL.

The writer has seen cores 5 to 8 ft. long taken with great ease in wells as deep as 4500 ft. Coring is doing much to remove the prejudice which so many petroleum engineers seem to have against the use of rotary drilling equipment for exploratory work. Some operators are now claiming that when used with a reasonable amount of coring the rotary system is even more satisfactory than cable tools for exploring in certain territory. A case has recently been pointed out in the South Electra field of North Texas, where producing oil sands, passed over by cable-tool drillers, are being brought in with rotary equipment.

It seems that in this particular territory the sands are rather thin. Cable-tool drilling was carried on for the most part in a wet hole and the red mud encountered in drilling caved into the hole very badly, so that the cuttings showed mostly red mud and the driller, thinking that the sand did not amount to anything, carried his water string through the sand. The later operators, drilling into the sand with rotary equipment and coring it, found that it was well worth testing. Wells producing from 50 to 500 bbl. per day have resulted. The tables seem to be turning, in the old arguments against the rotary.

Coring can be carried on just as quickly and with a great deal more safety with rotary drilling equipment than with regular core-drilling machines when drilling in the soft and unconsolidated formations of the Gulf Coastal plain. The writer is very doubtful as to the possibilities of adapting regular core-drilling machines to Gulf Coast conditions.

In working on the problem of taking cores when drilling by the rotary system in this territory, some very ingenious devices have been perfected. These group themselves naturally into the non-reaming and reaming types.

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The basket, or toothed, barrel, a non-reaming type barrel, is made from an ordinary piece of drill pipe by cutting teeth in one end. The teeth should be so cut that when they are bent together in effecting closure there will be no wide apertures through which soft sands can escape. The number of teeth depends on the size of the barrel and the type of formation to be cored. The most common size of barrel is the 4-in., but for deep work the 3-in. barrel is often used. The 4-in. barrel will have five or six sharp teeth for coring in soft sands or four flat teeth for coring in hard formations. Some drillers, when coring anhydrite or limestone, use only a single notch cut in the barrel. The barrels with the teeth are usually annealed before running and are usually 3 to 5 ft. long.

### Use of Basket-type Barrel

The common procedure in running this type of barrel in soft formations is to lower it on the drill stem into the hole until the bottom of the barrel is about 2 ft. off bottom. The swivel is then connected and the mud pump is operated for a few minutes until all material that may have entered the drill stem during its descent is pumped out. With the pump still working, the drill stem is lowered to within a few inches of the bottom. The pump is stopped and the core barrel is rotated downward until 3 or 4 ft. of core have been taken. While lowering the drill stem, the driller is careful not to put too much weight on the barrel; when a sufficient amount of core has been taken, he allows the full weight of the stem to rest on the barrel, while rotating, in order to effect closure. He may raise the stem and drop it a few inches to assist in the closing of the bottom of the barrel. If coring in rock, the driller may unscrew the swivel and drop in some pieces of gravel, glass, or cast iron, and pump them down around the core. By raising the stem and lowering it these pieces get jammed around the core and hold it until it is removed from the hole.

### Advantages and Disadvantages

This type of core barrel is simply screwed on to the end of the drill stem, no back pressure valve being used. A $\frac{5}{8}$-in. hole, called a "weep" hole, is usually bored in the top of the barrel, which permits the drill mud to escape from the stem as it is removed from the hole. The Hughes Tool Co. of Houston is making a special collar to be used in connecting the core barrel to the drill stem. This collar is about 18 in. long and is made from a drop forging with a ground seat $\frac{3}{4}$ in. in diameter in the center of the collar. The ground seat is at the top of the opening through the collar. About 3 in. above this ground seat, there is a $\frac{5}{8}$-in. weep hole opening to the outside of the collar. Coring proceeds as described above, when using this tool, until the driller is ready to pull out. At this point the driller drops a steel ball 2 in. in diameter into the drill stem, which becomes lodged on the ground seat and acts to keep the drill mud from washing through the core barrel and washing out the core as the drill stem is being removed from the hole.

Hundreds of operators are using the basket-type core barrel in Texas and Louisiana. It has the advantage of being relatively inexpensive and easy to make. The following objectionable features have been pointed out in connection with its use:

*Hole not Reamed to Gage.*—After taking a core with this device it is necessary to ream the hole to gage. This takes almost double drilling time and hence adds to the cost of drilling. It has the advantage of allowing the driller to "rat hole" ahead and if the sand cored carries values he may be able to land pipe on top of the sand. This advantage is somewhat problematical, however, as it is extremely doubtful that an operator could land pipe as close to a sand as would be necessary with a coring device taking such short cores.

*Chemical Constituents of Sand Leached Out.*—Due to the fact that the drill mud, which ordinarily contains fresh water, comes in intimate contact with the core, any saline constituents may be leached out before the core is removed from the hole. This is a very serious objection as the operators always want to know whether or not the sand cored contains salt water.

*Core Apt to be Injured by Heat.*—Several writers have recently pointed out the fact that cores are sometimes badly burned or fused from the heat generated while effecting closure. In many cases this heat is sufficient to weld the cutting teeth together and shale cores have been melted into a slag resembling volcanic rock. Of course this completely destroys all of the original characteristics of the core and it is decidedly not to be desired. Cases of burnt cores are relatively rare in proportion to the number of cores taken.

*Cores Lost Due to Failure of Core Barrel to Close.*—This condition arises in the coring of soft sands where complete closure is not effected. Also, in the taking of rock cores, it sometimes happens that they do not catch the core. Accidents of this kind are expensive due to time lost and failure to get accurate sample.

### Auger-type Core Barrel

The auger-type barrel, non-reaming, shown in Figs. 1 and 2, is not really a coring device, as the formation is considerably cut up in getting it into the barrel. Probably it would be more correct to call it a sampling device, but because it is used for the same purpose as the ordinary core barrel it is included in this discussion. This tool has a cutting action somewhat similar to that of an ordinary auger; it is made by cutting and bending a lip over the bottom of a piece of pipe.

These barrels usually are run without pump circulation, and in that case no back-pressure valve is used. If the pump circulation is used while coring, it is necessary to use the back-pressure valve, as shown in Fig. 2. This type of barrel does not have to be closed when pulled out; the lip is relied on to hold the sample in the barrel; samples of very loose sands are sometimes lost. Because the barrel is not closed, there is no heat generated; hence this method does possess some advantage over the basket-type barrel. Except for this one point, the auger-type barrel has all of the objectionable features of the basket-type barrel.

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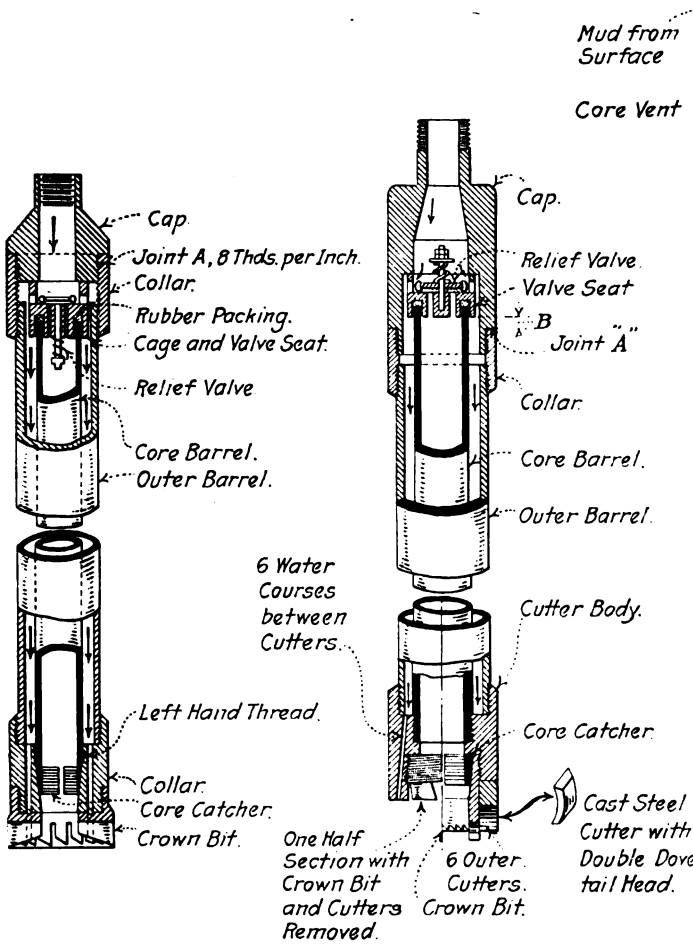
The Reed and Hepler coring tool (sometimes referred to as the R & H tool) is a reaming type of core barrel that has only recently appeared in the Gulf Coast fields. It is manufactured by the Reed Roller Bit Co. of Houston, Tex., and is shown in detail in Fig. 3. This tool seems to possess more of the desirable features of a coring device than any other which has come to the attention of the author. It possesses the following advantages:

*Length of Core Taken.*—This core tool is usually made up in 10-ft. lengths in order to make it a convenient tool to handle. This will accommodate a core 7 to 8 ft. long, but the tool can be made in any multiple of 10-ft. lengths, and there is no reason why 30-ft. cores could not be taken in certain types of formations. This is a very important advantage over the basket-type core barrel.

*Device for Retaining Core.*—This tool has four blades *d* suspended on pins. These are so suspended within the barrel that they tend to bear against the core. Any downward movement of the core causes these blades to move inward. The closure




FIGS. 4 AND 5.—OILFIELDS-HOLLAND CORE BIT.

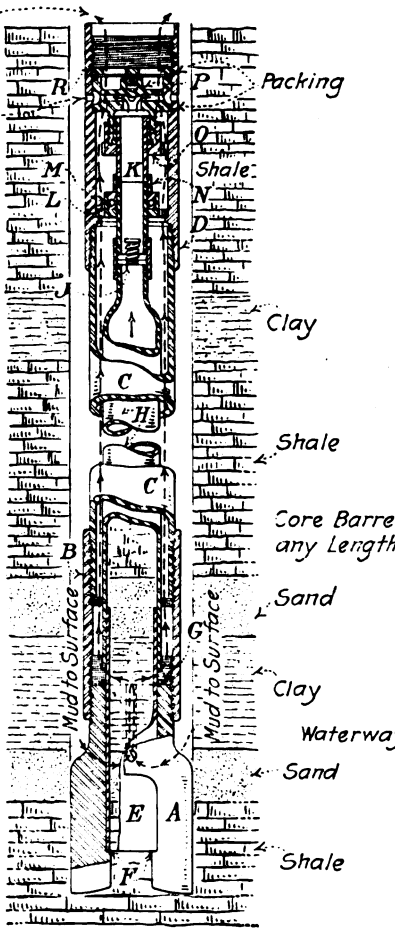



FIG. 6.—KNAPP COMBINATION CORE BARREL AND FISHTAIL BIT.

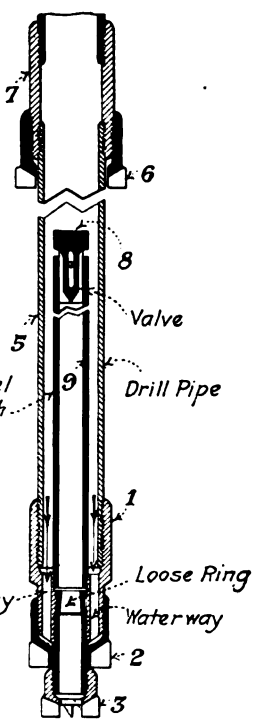



FIG. 7.—ACME CORING TOOL.

## ADVANTAGES OF REED AND HEPLER CORING TOOL

*Hole Carried to Full Gage During Coring Operations.*—This is accomplished by the use of inserted cutting teeth *a* as shown in Fig. 3. Mud is circulated constantly during the operation of this tool and the teeth cut an annular portion of the hole, the cuttings from which are returned to the surface in the drill mud.

*Barrel Kept Clean Until Coring Starts.*—This is accomplished by the small plug bit *b* which is screwed in place in the bottom of the barrel from the inside of the barrel on assembly. When the core tool is placed on bottom the blade of the plug bit is engaged in the formation. When rotation begins it remains stationary and the core tool unscrews down over it. As the coring proceeds the released plug bit and guide *c* ride up into the core barrel on top of the core.

*Core Not Leached of Saline Content While in the Barrel.*—On account of the barrel being kept closed and the method of cutting core, it is claimed that the sand core when removed from this type of coring device will come very close to having its original saline content.

effected by these blades depends on the hardness of the core. When coring in soft sands the blades come together in an "orange-peel" style and effect almost perfect closure.

*No Pump Pressure on Core Moqing up into Barrel.*—In coring tools using back pressure valves any core moving up into the barrel has to overcome the pressure of the column of mud moving downward. This amounts to quite a good deal in some cases and exceedingly soft material is apt to sluff off rather than move into the barrel. In the Reed and Hepler tool, the ascending core forces the fluid which is in the barrel upward and outside the drill stem at *e*. At the point *e* the drill mud is ascending and hence there is no downward pressure against the core.

*Circulating Drill Mud does not Contaminate Core.*—The drill mud in this tool comes out of the holes in front of the cutting teeth. It is prevented from getting at the material being cored by the protecting sleeve *f*.

Perfect cores are taken with this tool in sands as fine as quicksand. The writer has seen cores 7 and 8 ft. long taken at a depth of 3200 ft. In taking a series of

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cores at great depth, there is usually great wastage in soft materials. This causes gaps to occur in the sequence of the cores. The R. & H. core tool lost only 5 ft. of formation in coring 160 ft. of loose sands and shales and hole was made faster than when drilling in the same character of formation with a fishtail bit.

### Oilfields-Holland Core Bit

The Oilfields-Holland core bit shown in Figs. 4 and 5 has been used to some extent in California. The advantages of this tool are given by R. M. Barnes in a report to the California State Mining Bureau as follows:

The "core catcher" releases itself with only a slight downward movement if frozen.

The inner barrel will not turn, which is an improvement over the "Holland" bit for use with the stratameter.

The head facilitates removal of the core, as when the cap is removed at point *A*, the inner core barrel projects above the outer core barrel. In the most recent design, the top of the inner core barrel is made flush with the top of the outer barrel.

The construction of the cutting bit in the "Holland" type was retained because the core does not wash away as easily as in the "Oilfields" type. The water courses are outside of the cutting teeth instead of inside.

Improvements have been made in the combined "Oilfields-Holland" bit which calls for much heavier construction. than that used in previous bits because of the strenuous requirements imposed by deep rotary holes and tough formations. Of course the core barrel may be made of any length, but practice has shown that a core longer than 2 ft. is not essential and usually can not be secured.

It might be pointed out that the R. & H. coring tool possesses the following advantages over the Oilfields-Holland tool:

The Oilfields-Holland tool goes to the bottom of the hole open and the core barrel may become partly filled with debris on the way down.

In the Oilfields-Holland barrel, the core must move upward against pump pressure.

The core catcher of the R. & H. tool is much more positive in its action and would be more certain of retaining a core of soft material.

### Knapp Core Barrel

This tool, invented by I. N. Knapp, is described by R. E. Collom in a report to the California State Mining Bureau as follows:

This tool has been operated successfully in ordinary rotary drilling, taking cores of both soft and hard formations. As much as 16 to 18 ft. of hole has been made in one run, giving 12 to 14 ft. of core, in pieces, with a maximum length of 18 in. Fig. 6 is a sectional view of the apparatus complete. *A* is an ordinary 11-in. fishtail bit with 6-in. shank bored out to 4-in. pipe. *B* is an ordinary 6-in. drill coupling. *C* is a 6-in. drill pipe. *D* is a special drill coupling that supports and swivels the core barrel and is provided with vent holes to equalize the pressure on the core. *E* is a piece of 4-in. pipe forming the lower end of the core barrel. It is held from dropping through the bit by the offset *F*, in the bit *A*; and from pushing up, by the ring *G*. *H* is the main core barrel made of a joint of 4½-in. pipe, swaged to 2½ in. at the top and on this is attached a 2½-in. coupling. *J* is a back pressure valve. *K* is the swivel pipe. *L* is a perforated annular ring that supports the core barrel. *M* is a ball-bearing supported on *L*, carrying the coupling attached to the swivel pipe, thus supporting the core barrel. *N* is a coupling supporting swivel pipe and core barrel. *O* is a packing box. *P* is the head through which the core barrel is vented to the ascending fluid. *R* is a perforated follower to hold *P* in place. One disadvantage is that the barrel is likely to become partly filled with debris before coring starts; also, the fluid nozzle is about a foot too far away from the cutting edge of the fishtail bit to obtain the best drilling effect.

### Future of Reaming-type Coring Tools

The Acme bit, which is made in Shreveport, La., is shown in Fig. 7. The writer is not familiar with its use but simply shows it as another type of coring tool.

Coring tools of the reaming type probably will come into much more general use in the Gulf coastal fields within the next few years. Holes can be made just as fast with them as with a fishtail bit. It is not at all impossible that soon these tools will displace fishtail bits altogether in territory where accurate samples of any kind are needed. For coring soft formations, their superiority over other devices cannot be questioned and when tools of this kind are used with rotary drilling equipment the formation samples are superior to those obtained in cable-tool drilling.

## Discovery of Palladium*

PALLADIUM was originally made known to the public by an anonymous handbill which was circulated in London, announcing that palladium, or new silver, was on sale at Mrs. Forster's, and describing its properties. Chenevix, in consequence of the unusual way in which the discovery was announced, naturally considered it as an imposition on the public. He went to Mrs. Forster's, purchased all of the palladium in her possession, and set about examining it, prepossessed with the idea that it was an alloy of some two known metals. After a laborious set of experiments, he considered that he had ascertained it to be a compound of platinum and mercury, or an amalgam of platinum, made in a peculiar way which he describes in a paper read at a meeting of the Royal Society.

Soon after this publication, another anonymous handbill was circulated, offering a considerable price for every grain of palladium made by Mr. Chenevix's process, or by any other process whatever. No person appearing to claim the money thus offered, Doctor Wollaston, about a year after, in a paper read to the Royal Society, acknowledged himself to have been the discoverer of palladium, and related the process by which he had obtained it from the solution of crude platina in *aqua regia*, incident to his process of manufacturing platinum. There could be no doubt, after this, that palladium was a peculiar metal, and that Chenevix, in his experiments, had fallen into some error, probably by inadvertently employing a solution of palladium instead of a solution of his amalgam of platinum, and thus giving the properties of one solution to the other.

*Issued by Engineering Foundation: Secretary, A. D. Flinn, 29 W. 39th St., New York. From "History of Chemistry," 2, 216, Thomson.—G. Gore, in "The Art of Scientific Discovery."

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# Powdered Coal in the Lead Blast Furnace

By E. H. HAMILTON
Metallurgist, U. S. Smelting Co., Midvale, Utah

WHEN starting a series of experiments on the use of powdered coal in lead blast furnaces to replace coke, I realized that in copper smelting the problem is simpler because the sulfur recovers the copper in the form of matte. In lead smelting there are greater difficulties because a reducing atmosphere must be maintained in the active zone corresponding to each tuyere in order to get the best recovery of lead. Therefore, the feed of powdered coal must be quite regular, uniform and under control. The molten products issuing from the taphole are the resultant of the work of all the tuyeres and it can readily be conceived that one part of the furnace may be forming slag with a higher lead content than the slag formed in other parts of the furnace.

At first, we used only one tuyere situated on the back of the furnace. This was for the purpose of getting all of our regulations under the regular operating conditions. We tried every known system of feed and found they were not dependable and our present system was finally worked out, and so far as we know, is the only working system that will give uniformly good saving in lead blast furnaces.

We placed a Bristol self-recording thermometer on the feed floor. This gives a 24-hr. continuous record of the temperature of the gases leaving the furnace. We put a self-recording gage on the "15-lb." air used in the injector. A second recording Bristol gage was put on the low-pressure air (40 oz.).

I realized that it was necessary that we should know the exact weight of coal going into each tuyere and that it should be under observation at all times. L. W. Kirk was assigned to the problem and developed the open sight feed and the distributor, so that we now have the coal being fed into each tuyere in sight of the men in charge. We have an apothecary's balance beside the furnace, and the operator takes the pan and inserts it under the stream of falling powdered coal for one minute, and places the pan on the scale, the other scale pan having weights indicating the desired amount to be fed to each tuyere per minute.

This arrangement gives a complete record of: The weights of each constituent of the charge going into the blast furnace; the temperature at all times on the furnace top; the pressure at the injectors (15-lb. air); the pressure at the tuyeres (40-oz. air); the exact weight of coal going into each tuyere per minute; the exact weight of coke fed with the charge; the cubic feet of high-pressure air from the counter on the blowing engine; a fair estimate of the cubic feet of low-pressure air from the revolutions of the Root blower.

The quantities are about as follows: The 40-oz. air to the furnace is about 5000 cu. ft. free air per minute, or 207 to 257 cu. ft. free air per minute per tuyere; the 15-lb. air (9 lb. at tip of injectors) is 40 to 50 cu. ft. free air per minute per tuyere; total air 5000 to 6000 cu. ft. per minute; total coke averages 9 per cent.; total powdered coal 4 per cent.; total powdered coal 90 to 100 oz. per minute on each side of the blast furnace, according to furnace requirements; temperature on the top of the blast furnace about 250° F. (124° C.)

On my previous experiments with oil in blast furnaces, I was able to observe the distribution of the blast from each tuyere and found that the oil and the blast spread to one or two tuyeres on each side of the one in which the oil was introduced, but that conditions varied from time to time, and so I inferred that to use powdered coal in a lead blast furnace in which the lead contents are so easily driven into the slag, it is necessary to be able to control the feed of coal in order to obtain the best results.

In the ordinary method of operation, the coke is dumped into the top of the blast furnace as carefully as possible, but by the time it reaches the bottom of the furnace, it may be displaced, as for example by projecting crusts. The coke may take 8 to 10 hr. to reach the tuyeres and get in its work. In the case of powdered coal, we find that each tuyere has its limit, beyond which one cannot inject more coal, but that all the coal which the tuyere will take without becoming clogged is necessary in order to obtain the best reduction.

In this way, we are reminded that the percentage of lead in the slag formed at the various parts of the furnace varies, but if the lead in the slag is high, it can be corrected almost instantly by increasing the coal fed to the furnace. Each tuyere may not absorb the same amount of coal. By means of a speed regulator on the second floor the coal feed is adjusted as desired.

One of the radical differences in the operation of blast furnace with powdered coal as compared with coke is that, if the feed of powdered coal is constant and if the rate of smelting in the blast furnace for any reason, slows, the per cent. of fuel fed is increased. The slowing of the furnace increases the per cent. of coal, and an excess of coal slows down the furnace and thus the slowing process is accelerated. If the fuel is too low, the furnace speed increases and the increased

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speed lowers the per cent. of coal. This tends to speed the furnace and runs more lead into the slag. If the lead in the slag is high the speed of the coal feeder is increased. The results of three screen tests on powdered coal for testing purposes were as follows:

| Per Cent. on 48 | Per Cent. on 65 | Per Cent. on 100 | Per Cent. on 150 | Per Cent. on 200 | Per Cent. Through 200 |
|---|---|---|---|---|---|
| 0.13 | 1.50 | 7.0 | 5.0 | 12.0 | 74.37 |
| 0.00 | 1.60 | 5.0 | 5.0 | 13.0 | 75.40 |
| 0.24 | 3.32 | 11.0 | 8.0 | 15.0 | 62.43 |

A number of measurements of jacket water showed that the furnaces that were running on coke only were using 44.8 gal. of water per minute, while the furnaces on coal and coke were using 34.8 gal. of water per minute. This proportion is not always maintained, but the coal penetrates the charge and is not burned unduly close to the jackets.

We find the tonnage of the coal-fired furnace is reduced about 6 per cent., but we hope to overcome this later. Coke keeps the air passages open and does not melt. It will be noted that we get a better saving in metals. This is partly due to lower speed. The following tables embodying some of the results of our tests have been prepared by D. W. Jessup, the first table covering a run of one blast furnace using powdered coal over a period of 61 days as compared with other furnaces on the same charge but using coke as fuel.

TABLE 1

| | Furnace on Coal and Coke | Other Furnaces on Coke Only |
|---|---|---|
| Per cent. lead in slag (wet lead) | 0.86 | 0.907 |
| Per cent. lead in matte | 13.3 | 14.7 |
| Average tons charge per day | 212.1 | 233.9 |
| Average tons bullion per day | 20.8 | 22.8 |
| Average tons matte per day | 13.87 | 13.5 |
| Per cent. bullion fall | 9.92 | 9.9 |
| Per cent. matte fall | 6.54 | 6.76 |
| Per cent. coke | 9.8 | 13.57 |
| Per cent. coal | 3.2 | 0.0 |
| Per cent. total coke and coal | 13.0 | 13.57 |

Another run using another blast furnace for the powdered coal gave the following weekly averages, all furnaces on the same charge, except coal and coke:

TABLE 2

| | Furnace Using Powdered Coal | Avge. Furnace on Coke Only |
|---|---|---|
| Per cent. lead in slag (wet lead) | 0.766 | 0.951 |
| Per cent. lead in matte | 13.1 | 14.9 |
| Average tons charge per day | 219.4 | 230.9 |
| Average tons bullion per day | 25.3 | 26.0 |
| Average tons matte per day | 16.9 | 16.5 |
| Per cent. bullion fall | 11.5 | 11.3 |
| Per cent. matte fall | 7.7 | 7.2 |
| Per cent. coke | 9.9 | 12.62 |
| Per cent. coal | 3.43 | |
| Per cent. total coke and coal | 13.23 | 12.62 |

TABLE 3.—*Partial Distribution of Heat in Lead Blast Furnaces*

No consideration is given to heat developed in the furnace except B.t.u. from burned coke and coal

No. 1 furnace on coal and coke. No. 4 and No. 5 furnaces on coke charge.

Temperatures by optical pyrometer, B. t. u. by homemade calorimeter.

No. 1 Furnace, June 6, 1920, 14 Four-ton Charges per Shift

| | B. t. u. Per Minute |
|---|---|
| Slag, 1800° F., 2025 B. t. u. per lb. at 145.9 lb. per min | 295,450 |
| Bullion, 1250° F., 789 B. t. u. per lb. at 29.1 lb. per min | 22,950 |
| Matte, 1625° F., 1472 B. t. u. per lb. at 17.5 lb. per min | 25,890 |
| Latent heat of evap. $H_2O$ in ore | 12,900 |
| Jacket $H_2O$ | 29,000 |
| Air from blast, 5150 cu. ft. per minute at 160° F. temperature change | 82,500 |
| Radiation from furnace, settler, monkey pot, etc. (assumed) | 15,000 |
| Total B. t. u. per minute | 483,500 |
| Coke, 820 lb. per charge at 12,300 B. t. u. per lb | 294,000 |
| Coal 6.25 lb. per minute at 13,400 B. t. u. per lb | 83,150 |
| Total | 337,150 |
| Gained from other sources than coke and coal | 106,450 |

No. 5 Furnace, June 4, 1920, 16 Charges per Shift

| | B. t. u. Per Minute |
|---|---|
| Slag 1990° F | 295,200 |
| Bullion 1380° F | 24,250 |
| Matte 1660° F | 24,460 |
| Latent heat in moisture | 14,700 |
| Jacket $H_2O$ | 35,000 |
| Air | 86,500 |
| Radiation | 15,000 |
| Total | 495,110 |
| Coke | 426,400 |
| Gained from other sources than coke | 68,710 |

No. 1 Furnace, June 7, 1920, 15 Charges per Shift. (Charge 8000 Lb. Omitting Fuel)

| | | B. t. u Per Minute |
|---|---|---|
| Slag 1920° F., 2080 B. t. u. at 156.2 lb. per min | | 325,000 |
| Bullion 1310° F., 973 B. t. u. at 31.2 lb. per min | | 30,350 |
| Matte 1660° F., 1331 B. t. u. at 18.7 lb. per min | | 24,900 |
| Latent heat in moisture | | 13,800 |
| Jacket $H_2O$ | | 29,000 |
| Air | | 82,500 |
| Radiation | | 15,000 |
| Total | | 520,500 |
| Coke | 407,200 | |
| Coal | 91,600 | 407,200 |
| Gained from other sources than coke and coal | | 113,350 |

No. 4 Furnace, June 7, 1920, 16 Charges per Shift

| | B. t. u. Per Minute |
|---|---|
| Slag 1930° F., 1731 B. t. u. at 166.7 lb. per min | 288,600 |
| Bullion 1395° F., 636 B. t. u. at 33.3 lb. per min | 21,200 |
| Matte 1680° F., 1426 B. t. u. at 20.0 lb. per min | 28,500 |
| Latent heat in moisture | 14,700 |
| Jacket $H_2O$ | 35,000 |
| Air | 86,500 |
| Radiation | 15,000 |
| Total | 489,500 |
| Coke | 426,400 |
| Gained from other sources than coke | 63,000 |

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No. 4 Furnace, June 6, 1920, 14 Charges per Shift. (Charge 8000 Lb. Omitting Fuel)

| | B. t. u. Per Minute |
|---|---|
| Slag 1825° F., 1692 B. t. u. at 145.9 lb. per min | 246,870 |
| Bullion 1325° F., 660 B. t. u. at 29.1 lb. per min | 19,200 |
| Matte 1625° F., 1128 B. t. u. at 17.5 lb. per min | 19,700 |
| Latent heat in evap. $H_2O$ | 12,900 |
| Jacket $H_2O$ | 35,000 |
| Air | 86,500 |
| Radiation | 15,000 |
| Total | 435,170 |
| Coke | 373,100 |
| B. t. u. gained | 62,070 |

No. 1 Furnace, June 4, 1920, 15 Charges per Shift.

| | | B. t. u. Per Minute |
|---|---|---|
| Slag 1860° F., 1731 B. t. u. at 156.2 lb. per min | | 270,400 |
| Bullion 1340° F., 648 B. t. u. at 31.2 lb. per min | | 20,200 |
| Matte 1440° F., 1186 B. t. u. at 18.7 lb. per min | | 22,200 |
| Latent heat evap. $H_2O$ in ore | | 13,800 |
| Jacket $H_2O$ | | 29,000 |
| Air | | 82,500 |
| Radiation | | 15,000 |
| Total | | 453,100 |
| Coke | 315,600 | |
| Coal | 91,600 | 407,200 |
| B. t. u. gained | | 45,900 |

## Luncheon for Doctor Giolitti

A LUNCHEON in honor of Dr. Federico Giolitti, of Turin, Italy, was given by Charles F. Rand, in the name of the Iron and Steel Committee of the Institute, at the Bankers Club, New York, Sept. 26. Doctor Giolitti, the son of the Prime Minister of Italy, is an Italian metallurgist who was managing director, during the war, of the Great Ansaldo works at Genoa. These works gave one of the classic exhibitions of patriotism of the war. Before Italy entered the war, the owner of this plant, foreseeing her ultimate entry, tried to get the Government to begin the manufacture of guns. After several futile attempts, he began on his own initiative, and when Italy finally declared war and frantically called on him to begin and hasten the manufacture of artillery, he had 2000 guns ready for shipment, built on his own resources and responsibility.

Doctor Giolitti, who is revisiting America, is not only an eminent investigator but an equally eminent executive. This luncheon was tendered to him as he is about to return to his own country. Happy and felicitous speeches were made by several members present regarding Doctor Giolitti's work and the growing movement for a national association of engineers, which is promised as soon as a simple plan can be devised for its creation. The guests present were:

Dr. Federico Giolitti, guest of honor; M. Gaston Liebert, Consul General of France; Comm. Francesco Quattrone, consulting engineer; Col. Percy E. Barbour, asst. secy., Am. Inst. of Min. and Met. Engineers; Edward D. Adams, vice-chairman, Engineering Foundation; Wm. Campbell, professor of metallurgy, Columbia University; Frank D. Carney, consulting metallurgist; Alfred D. Flinn, director, Engineering Foundation; James T. Grady, Dept. of Public Information, Columbia University; John H. Hall, secretary,

Table 4.—*Heat Balance, Lead Blast Furnaces, 48 by 160 In., Midvale, Utah*

| Date, June, 1920 | Furnace No. | Charges per Shift (4 t. p. c.) | Pounds Coke on Charge | Lb. Coal per Min. | Slag Temp. °F. | Bullion Temp., °F. | Matte, Temp., °F. | Slag, B. t. u. per Min. | Bullion B. t. u. per Min. | Matte, B. t. u. per Min. | Latent Heat in Moisture in Ore | Jacket Water, B. t. u. per Min. | Blast Air | Radiation Assumed | Total B. t. u. Given Out | B. t. u. in Fuel | B. t. u. from Other Sources |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 1 | 15 | 820 | 6.88 | 1860 | 1340 | 1440 | 270,400 | 20,200 | 22,200 | 13,800 | 29,000 | 82,500 | 15,000 | 453,100 | 407,200 | 45,900 |
| 6 | 1 | 14 | 820 | 6.25 | 1800 | 1250 | 1265 | 295,450 | 22,950 | 25,800 | 12,900 | 29,000 | 82,500 | 15,000 | 483,600 | 377,150 | 106,450 |
| 7 | 1 | 15 | 820 | 6.88 | 1920 | 1310 | 1660 | 325,000 | 30,350 | 24,900 | 13,800 | 29,000 | 82,500 | 15,000 | 520,550 | 401,200 | 113,350 |
| Total | | 44 | | 20.01 | 5580 | 3900 | 4725 | 890,850 | 73,500 | 72,900 | 39,500 | | | | 1,457,250 | 1,191,550 | 265,700 |
| Avg | 1 | 14.67 | 820 | 6.67 | 1860 | 1267 | 1575 | 297,000 | 24,500 | 24,300 | 13,170 | 29,000 | 82,500 | 15,000 | 485,750 | 397,180 | 88,570 |
| 4 | 5 | 16 | 1040 | | 1990 | 1380 | 1660 | 295,200 | 24,250 | 24,460 | 14,700 | 35,000 | 86,500 | 15,000 | 495,110 | 426,400 | 68,710 |
| 6 | 4 | 14 | 1040 | | 1825 | 1325 | 1625 | 246,870 | 19,200 | 19,700 | 12,900 | 35,000 | 86,500 | 15,000 | 435,170 | 373,100 | 62,070 |
| 7 | 4 | 16 | 1040 | | 1930 | 1395 | 1680 | 288,600 | 21,200 | 28,500 | 14,700 | 35,000 | 86,500 | 15,000 | 489,500 | 426,400 | 63,100 |
| Total | | 46 | | | 5745 | 4100 | 4965 | 830,670 | 64,650 | 72,660 | 42,300 | | | | 1,419,780 | 1,225,900 | 193,880 |
| Avg | | 15.33 | 1040 | | 1915 | 1367 | 1655 | 277,000 | 21,550 | 24,220 | 14,100 | 35,000 | 86,500 | 15,000 | 473,630 | 408,630 | 64,630 |

| | No. 1 | No. 4 |
|---|---|---|
| B. t. u. per lb. slag | 1945 | 1731 |
| B. t. u. per lb. bullion | 803 | 675 |
| B. t. u. per lb. matte | 1330 | 1259 |

Remarks: No. 1 Furnace on coal and coke. Nos. 4 and 5 on full coke. Temperatures in degrees F. by optical pyrometer, inaccurate on account of smoke interfering. B. t. u. by home-made calorimeter. B. t. u. in coke 12,300 per lb.; in coal 13,300 per lb. Blast air No. 1 Furnace, 5150 cu. ft. per min. No. 4 Furnace 5400 cu. ft. per min.

The furnace now on powdered coal (October, 1921) has run continuously for seven months, and apparently is in as good condition as at the start. We are learning all the time and the men have got rid of their prejudices against the method.

The funds for carrying on the work were supplied by the U. S. Smelting, Refining and Mining Co., in accordance with its progressive policy.

To Messrs. A. E. Erickson, engineer; L. W. Kirk, research engineer; R. Wallace and D. W. Jessup, metallurgists; Mr. McGinnis, master mechanic, and N. Jensen, chemist, are due our thanks for their enthusiastic coöperation.

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Iron and Steel Committee A. I. M. E.; Henry D. Hibbard, consulting metallurgist; W. R. Ingalls, consulting engineer; A. H. Jameson, vice-president, Bayonne Steel Casting Co.; Wilber Judson, Texas Gulf Sulphur Co.; A. R. Ledoux, past president, Am. Inst. Min. and Met. Engrs.; Edwin Ludlow, past president, Am. Inst. Min. and Met. Engrs.; John W. Lieb, past president, Am. Soc. Electrical Engrs.; D. A. Lyon, chief metallurgist, U. S. Bureau of Mines; John A. Mathews, president, Crucible Steel Co. of America; J. V. W. Reynders, vice-president, A. I. M. E.; Charles F. Rand, chairman, Engineering Foundation; Bradley Stoughton, chairman, Iron and Steel Committee, A. I. M. E.; W. R. Shimer, metallurgist, Bethlehem Steel Co.; W. L. Saunders, past president, Am. Inst. Min. and Met. Engrs.; Leonard Waldo, consulting metallurgist; Dr. Rossi, Italian Consul.

## Rights but not Privileges

"SOME DAY the labor leader will get his 'rights,' and the result may well surprise him," says the *Wall Street Journal.* "Hitherto he has confused the rights any citizen enjoys, or should enjoy, with privileges accorded to his class by legislation like the Clayton Act, the Adamson law, or the Transportation Act of 1920, or by a custom growing out of the cowardice of politicians.

"In what makes an admirable editorial, consisting of one brief sentence, F. F. V., 'columnist' of the New York *Tribune*, puts the matter succinctly:

> If the union leader doesn't stop squawking about his constitutional rights somebody is going to come along sooner or later with sufficient courage to give them to him.

"By the injunction obtained in the Federal Court at Chicago the labor leaders were startled into the realization of how far, by virtue of real and assumed privilege, they had departed from equality under the law. Without discussing the merits of that injunction, or even suggesting that the courts had granted the Attorney General more than he needed, the lesson should be plain to Mr. Gompers, Mr. Jewell of the striking shopmen, and to the more conservative leaders of the railroad brotherhoods. They have acquired the idea that it is possible in this country to be something more than an American citizen. Such a condition is purely artificial. It is bound to break down when the rest of the citizenship takes time off to show the claimant of privilege exactly where he stands.

"At the bottom of the shopmen's strike is a vicious national condition governing their work, which the strike itself may cure. President Alfred of the Pere Marquette Railroad points out what happens when a locomotive has been sent to the shop for repairs because of a broken stay bolt. Up to the time of the McAdoo administration of the railroads this was a matter which could be put right by a boilermaker and his helper, and in much less time than such a replacement takes now. Here are the stages of the operation as laid down by the various shop crafts:

1. The cab carpenter and his helper remove the running board.
2. The sheet metal worker and his helper take off the jacket.
3. The pipemen remove the pipe.
4. The machinist and helper remove the running board bracket.
5. The ox-welder and helper burn out the staybolt.
6. The boilermaker and helper take out the staybolt.
7. The boilermaker and helper put in the staybolt.
8. The running board bracket is replaced by machinist and helper.
9. The running board is fastened on by a cab carpenter and helper.
10. The jacket is replaced by a sheet metal worker and helper.
11. The pipe work is replaced by a pipefitter and helper.

"Twelve men to do the work of two! This is merely one instance of many. Not only is needless work created in this utterly wasteful way, but the shop foremen are continually at a loss lest they offend some particular union in the allotment of work. They never know when a dispute between two of the unions will arise. There is no 'right' here involved, but a grievous wrong. If the shopmen think this sort of thing constitutes a 'right,' moral or legal, they will not find an intelligent man in the United States outside the shops, and unprejudiced by similar privilege, to agree with them.

"It was pointed out in these columns a few days ago that with a much reduced shop force some railroads are actually turning out more work than they were before the strike. It means that national conditions of the McAdoo kind have been scrapped and that common sense is eliminating lost motion. In other words, the labor leader is in a fair way to get his 'rights' and he doesn't like it."

## Federated Engineering Magazine

THE Federated American Engineering Societies has begun the publication of a monthly bulletin to replace its former mimeographed bulletins. It is expected that this bulletin will be expanded into a magazine, telling of the work and activities of the Federated American Engineering Societies, the American Engineering Council, its executive board, and its regular and special committees. In its initial editorial it says:

> "In addition to the major advantage of influence and leadership from such a publication, there is another possibility—contact with individual engineers—which is shown by the insistent demand on the part of members of constituent member societies. Almost since the organization of the American Engineering Council, the representatives of local and smaller national societies have requested a regular publication to be sent to the members of their societies. For these reasons, the possibility of broadening the influence of the Federated American Engineering Societies and satisfying the request of some 10,000 engineers, the Bulletin of the F. A. E. S. is issued in its present form.

The method of distribution of this magazine is not given, but it is intended for wide distribution and those desiring to be placed on its mailing list should address the Federated at 24 Jackson Place, Washington, D. C.

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# From New York to San Francisco with the Institute Party

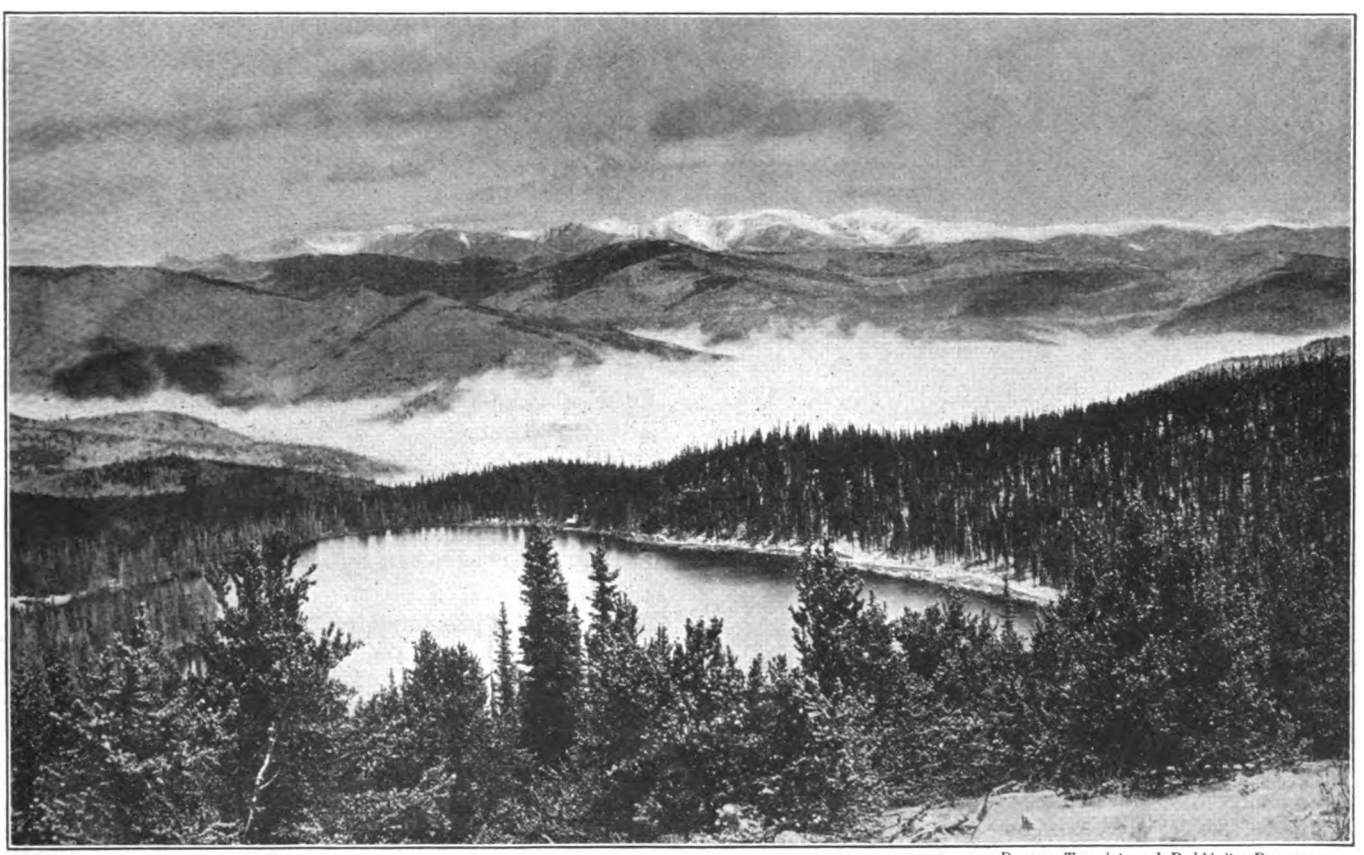
By F. F. SHARPLESS

Secretary, American Institute of Mining and Metallurgical Engineers

ON Saturday evening, Sept. 9, a small party of Institute members, their wives and friends, left New York to attend the Fall Meeting of the Institute at San Francisco. In this party there were: President and Mrs. Arthur S. Dwight; Mr. and Mrs. George D. Barron; Mr. and Mrs. H. J. Stehli; N. S. Spencer and Miss Spencer; the Secretary and Mrs. F. F. Sharpless. They were joined at Chicago by E. F. Eurich, and by Mr. and Mrs. R. L. Baldwin and daughter.

Our party was met at Chicago by Mr. and Mrs. L. V. Rice, Mr. and Mrs. A. D. Terrell and W. F. Boericke, who constituted themselves an impromptu entertainment committee and proceeded to carry out a delightful little program. We were taken to the Lake Shore drive, where a stiff wind off the lake refreshed us after a sultry day on the train, and on our return to the city saw Chicago illuminated with all its brilliance of electricity. We were entertained at dinner at the Drake Hotel.

In spite of being two hours late getting into Omaha, we were right on the dot at Denver on Tuesday morning. Horace F. Lunt came to the hotel soon after breakfast, and told us that a trip to the mountains had been planned. Having learned the number in the party, he began to gather up his automobiles for a 10 o'clock start.



*Denver Tourist and Publicity Bureau.*

ECHO LAKE, IN THE DENVER MOUNTAIN PARKS' SYSTEM. TWO MILES ABOVE SEA LEVEL. SNOW-CAPPED ROCKIES AND LOW-LYING CLOUDS IN THE BACKGROUND.

In the meantime, D. W. Brunton, finding some of the party with time hanging heavily on their hands, loaded them into his automobile and took them sightseeing until the official party was ready to start.

About a dozen automobiles were supplied for our use

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by the members of the Denver section, and the success of the trip was due to Mr. Lunt and the Executive Committee.

There was a ride of about 10 miles to the foot of the mountains, then a climb of 40 miles to Echo Lake, which lay as a little gem among the mountain tops just below timber line. The day was gorgeous for such a trip, cool and clear except for a few fleecy clouds, to break the monotony of the blue. A splendid automobile road has been built to the point where we were to take lunch and is to be built to the peak of Mt. Evans, 2000 ft. more into the air.

At Echo Lake we were met by members from Golden and at half past one sat down to a delightful lunch which had been prepared by our women friends of Golden and Denver. If their husbands know as much about mining and metallurgy as those women do about cooking, we must have some capable men in Colorado.

### Colorado School of Mines Visited

Soon after lunch we started on our return journey via Golden. The road followed took us right to the edge of the mountains overlooking the plains and the journey was so timed that the lights over the mountains and plains were at their best, while nature contributed to the success of the trip by furnishing just the proper amount of cloud effect. Buffalo Bill made an advertising success of himself during life and consciously or unconsciously has done the same thing for a good many of the years following his departure, by requesting that his body be buried at a spot overlooking a good part of the state of Colorado. There is a wonderful view from the place where his tablet lies on the ground and tourists from all over the world will stand there to admire the panorama spread out before them, and, incidentally, will note that there lie the bones of William F. Cody.

At the foot of the trail lies Golden, a very large part of which is the Mining School. The boys were at football practice, nevertheless quite a group of them gathered in the reading room on the campus to meet our group of engineers. They were addressed by President Dwight on the reasons why young engineers should be a part of the organization which represents their profession; the Secretary made a few remarks in the same direction. Mr. Brunton, the dean of engineers of Colorado, also said a few words.

The party was up bright and early for the trip through the Royal Gorge via the D. & R. G. and all went well until we reached Pueblo at noon. Here the station master informed us that there had been a freight wreck in the Gorge an hour or so earlier and that we could remain in Pueblo until further orders. To a program of which every hour was filled, this meant considerable dislocation.

At this juncture Judge Samuel Trimble and Mrs. Trimble, old-time friends of Colonel and Mrs. Dwight, put in an appearance, and volunteered to rescue the party from an afternoon of torture in the railway yards. We were in need of rescue from the heat almost as much as those who were caught in the same yards by the flood of June 3, 1921.

After luncheon Mrs. Trimble and Mrs. Quarles took the women of the party in their cars to the hospital of the Colorado Fuel & Iron Co., and, later, Judge Trimble took the men there, also. Under the able direction of Doctor Corwin, this hospital has been developed into one of the most complete and efficient of the entire west; one in which it would be almost a pleasure to be confined.

From the hospital, our host took us to the Minnequa Club, a country club not far distant, where we remained for the rest of the afternoon. The clouds gathered around the Spanish Peaks 90 miles south of us, the sun gradually sank toward the Sangre de Christo Range in the west, and we returned to the hot Pullmans at the station, lest a miracle should happen and the wreck be cleared away before the appointed time.

Finding that the miracle had not happened, we had a long distance conversation with H. M. Adkinson of Salt Lake, chairman of the Utah Section, and were regretfully forced to inform him that we could not be present at the banquet which had been arranged for the evening of the 14th. A large number of guests had accepted the invitation, including Governor Mabey, so it was with deep disappointment that we accepted our fate.

### Through the Royal Gorge

At midnight, our train was moved to the mouth of the Royal Gorge and there held until daylight of the 14th. Half an hour before time to start through the canyon, Mr. Baldwin came through the car with the announcement that we were to see the Gorge by early morning light, and soon the observation car was filled by those who had not previously been over the D. & R. G.

Sunlight was just touching the mountain tops around us as the whistle blew four times and we started up the Gorge. Had we not realized that the plans of the Utah Section had been seriously twisted, I think we might have thoroughly enjoyed this extra show. Later in the day our satisfaction was increased when we entered the canyon of the Grand River, which is even more inspiring than the Royal Gorge, and which would not have been seen at all if our train had been on schedule time.

### Salt Lake and Bingham Canyon

The party arrived at Salt Lake City about 7 a. m. on Sept. 15 without further incident, just 18 hours late. The program for the day was handed to us upon our arrival at the hotel, and a few minutes later Mr. Adkinson came to tell us that the autos were ready to take us out to the property of the Utah Copper Co.

After breakfast we were run out quickly to the Arthur

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mill, where we were met by several engineers of the company, an engine and a private car in which we were to be taken on an inspection trip of the mine. Few visitors have been offered such an exceptional opportunity to see the mine in Bingham Canyon, and its surroundings. We were switched back and forth up to near the summit of the hill that is being mined, and were then switched down over the face of the mine from the top to near the lowest level. The party is greatly indebted to the management for the courtesy which rendered possible an examination of the mine.

At noon we were taken as guests of the Utah Section to the club house of the Arthur mill for luncheon. At the mine we had been shown the proper methods of developing and handling a large low-grade deposit of ore; at the clubhouse, our women folk were shown the proper method of developing and baking cream cocoanut pie (and it was some pie!); thus we see that efficiency is shown in all departments of the company's works.

In the afternoon we were shown through the Arthur mill, which is now running at full capacity, 17,000 tons per day. The elimination of the Chile mills and the idle vanners of this mill, coincident with the adoption of flotation and increased recovery, are evidences of the progress of this company. The Magna mill of the same company, a short distance from the Arthur plant, is being thoroughly overhauled during its present idleness. When ready to start next fall it will be capable of handling 24,000 tons per diem, with better extraction than has hitherto been secured.

### The Utah Banquet

As previously mentioned, a meeting and dinner at the Hotel Utah had been arranged for the 14th, but with that characteristic Western spirit which is oblivious to any accidents, the date was changed at a few hours notice, invitations were recalled and re-issued.

About a hundred men and women came to meet the President and his party. After a delightful dinner, Chairman Adkinson made an address in which he called attention to the prominence of Utah in the mineral production of the United States, backing up his statements with official statistics which, in substance, said that Utah stood near the top.

President Dwight addressed the section on the problems and activities of the Institute. His speech was keenly listened to by the members, many of whom had not realized previously our activities.

The chief entertainment of the evening was an illustrated lecture by Lafayette Hanchette on "The Romance of Engineering." The lantern slides were from photographs taken by Mr. Hanchette several years ago during a trip around the world. They illustrated the progress in the development of the carrying industry from the primitive pack woman to present day rail transportation; from the primitive dugout to the ocean liner passing through the man-made Panama Canal; and also the building industry from the primitive dwelling made of sticks and mud to the commercial, ugly skyscraper, or to the useless but architecturally perfect structure, the Taj Mahal.

The Secretary of the Institute then spoke for a few minutes on the relation of the Section to the Institute, which was followed by handshaking for a half hour before proceeding to the midnight train for Butte.

### The Montana Copper Mines

We arrived in Butte exactly on time and were met by a big reception committee headed by John Gillie, manager of the Anaconda company and William Daly, assistant manager. About 20 men and women were in the party that greeted us, among them Mr. Goodale, who immediately kidnapped our one golf player, Mr. Barron, and made off with him. The rest of us were taken in private automobiles to the Thornton, where we had two hours for cleaning up and for dinner.

At 7.30 autos called for us and under the leadership of Mr. Daly, with a corps of assistants, we were taken to the Leonard shaft. Men and women were equipped with overalls, lanterns and caps and lowered to the 1200 level, the main pump level for that section of the property. After inspecting the pumping equipment, we were dropped to the 2800 level, where stoping and drifting are now in progress. The vein systems of this portion of the mine were explained to us. We were taken into the stopes and to the faces where drifts were being run. Two hours were spent at the mine. The unusual courtesy was keenly appreciated by our women folk who had never been underground before, as well as by the men who had never been underground at Butte.

The next morning, autos were waiting when we came from breakfast, and we were driven over the surface, visiting a number of the surface plants, including the converting stations and the compressor plant.

A drive out to Anaconda was the next thing in order. This is over a concrete road and the 28 miles were soon covered. Mr. Laist, with a number of his engineers and their wives, and E. P. Mathewson, were at the hotel to meet us. A delicious lunch was served. President Dwight addressed the party on the subject of Institute activities, and a few remarks were made by Mr. Laist, Mr. Mathewson and the Secretary.

Mr. Laist then conducted the men around the town and over the mill and smelter, while Mrs. Laist conducted the women over the same path with equal skill, showing that she, too, was perfectly familiar with the plant. After a busy afternoon, we were taken back to Butte and at 7 o'clock met at the Silver Bow Club for dinner. Mr. Daly, acting as toastmaster, introduced first the President, then, following one another, the Secretary, John Gillie, Geo. S. Rice, Mr. Simons, director of the School of Mines, and Mr. Linton. After a social half hour in the lobby of the club the visitors were taken out of town five miles to see Butte at night.

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It is a beautiful sight, for Butte has the reputation of being one of the best lighted cities in the United States.

Three and a half hours late out of Butte proved a blessing in disguise; it meant that we came into the head of the canyon of the St. Joe River just at getting-up time and that we met the train going to Wallace exactly when it arrived, instead of sitting at Plummer Junction waiting for it.

### In the Coeur d'Alenes

The train that took us to Kellogg was from Spokane and carried our friends L. K. Armstrong and F. M. Smith in a special car, from which we were shown the sights as we proceeded toward Kellogg. There we were met at the station by Mr. and Mrs. Stanly A. Easton and several engineers of the staff. We were conducted to the Y. M. C. A. where a substantial and extraordinarily good lunch was served.

Mrs. Easton took charge of the ladies while Mr. Easton piloted the men, first to the office where they shed their coats, then up to the head of the mill and down through the various steps to the slime department. There Mr. Smith and a corps of assistants took us in hand and passed us through the various departments from the Dwight-Lloyd plant at the top to the bullion bars in the safe. Seventy-five or eighty of the Bunker Hill and Sullivan force gathered at the Y. M. C. A. at 6.30 for dinner, at which our waitresses were the class in domestic science. After the dinner, short addresses were made by President Dwight, Rush White and the Secretary. These were followed by a series of lantern slides shown by Walter C. Clark, electrical engineer of the Bunker Hill, illustrating the progress in the development of the country and the mining and milling practice of the Coeur d'Alenes. In an hour's time we were given much of the history of the country, and learned more of the mining and milling than we could have learned in several days at the plants.

### Wallace, Spokane, Seattle and Portland

A half hour after the meeting, we were driven to Wallace in autos, where we spent the night at Samuels Hotel. In the morning, the ladies were taken for a drive over the mountains and the men visited the Hercules mine or the Morning mill. The party at the latter place, of which I was one, spent the morning under the care of Mr. Dunton and Mr. Pope. We lunched at the Morning mill, while the others were the guests of Mr. McCarty at the Hercules mine.

At 2.30 p. m. the party left for Spokane, some going by automobile, others by train.

At Spokane, Mr. Armstrong and his associates had arranged a most delightful dinner, at the Davenport, where 25 members and as many ladies had gathered to do honor to their guests from the East. During the evening, vocal selections were rendered and after it was over short addresses were made by President Dwight, Mr. Smith and the Secretary. A short reception was held by the men while Mrs. Dwight talked Auxiliary to the women.

At the station we found that the whole car had been reserved for us. The porter who was waiting for us apparently was quite surprised when he saw us walking down the platform. Later he explained that he had been advised to prepare to carry a load of *engineers* to Seattle, and he added: "I was wonderfully surprised when I saw a parcel of ladies comin'. I thought you was a party of strike breakers."

We were met at the Seattle station by a dozen or more members of the Seattle local section, who gave us a most enthusiastic welcome and then took us to the Engineers Club for lunch. The Engineers Club is composed of members of all the societies and representatives from all the societies honored us by their attendance at this luncheon. Our entertainment for the afternoon was a drive through the business section, the residence sections and the parks of the city.

Dinner in the evening was attended only by members of the Puget Sound Section and wives. Addresses were made by Amos Slater, by the President and by the Secretary.

We reached Portland early in the morning and while we were breakfasting at the Hotel Benson our Oregon members began to drop in. They were glad to see us, there was no simulation about this, and by the time we were all through breakfast automobiles were waiting at the front door. Two or three of us had been assigned to each, the remaining seats being assigned to local members and their wives. This gave a delightful opportunity for our members to become acquainted with a few of the local members. Our destination was the Columbian River drive, a splendid road through more than a hundred miles of wonderful scenery. The atmosphere was just sufficiently smoky and the clouds just right for bringing out the best effects of the mountains and river flowing between them. It is a drive that we will all want to take again. We returned to Portland for a late lunch, which was given by the members who had accompanied us in the morning and after luncheon the party, increased to about 20, was driven to the station.*

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Brazilian Centenary Exhibition | Rio de Janeiro, Brazil | Sept. 7, 1922 to Mch. 31, 1923 |
| Soc. Automotive Engrs. | Detroit, Mich. | Oct. 26–27 |
| Natl. Exposition Power & Mech. Engng | New York, N. Y. | Dec. 7–13 |

* The remainder of the trip, including the week in San Francisco will be described in the November Mining and Metallurgy.

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# Abstracts of Institute Papers

The following papers were presented at the San Francisco meeting September, 1922, and will be printed in full in pamphlet form.

A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 20 of the Advertising Section. Discussion of papers is invited.

## The Aztec Mine, Baldy, New Mexico

By Charles A. Chase, Denver, Colo., and Douglas Muir, Simon, Nev.

THE Aztec mine is not widely known by reason of its isolation and the relative insignificance of its tonnage; but financially it has an enviable record and geologically it is extremely interesting. The paper describes the geology and mineralization of the district, the mining and milling methods, and the costs.

The town of Baldy, Colfax County, the mine camp, at an elevation of 10,000 ft., is 8 mi. west of Ute Park, the terminus of a branch of the A. T. & S. F. Ry.

Rich copper float was found in 1865, and discovery work was begun the next year. At the same time, gold placers were found on Willow Creek. Gold washing lasted many years. In 1867, placer gold was found also on Ute Creek, the tracing of which to its source led to the locating of the Aztec mine in the following year.

The early production came from the contact of shale and sandstone or from sandstone immediately above the contact. Exact record of production is lacking, but L. C. Graton gives estimates ranging between $1,250,000 and $1,500,000 of which about $1,000,000 was taken out in the first four years.

After the exhaustion of the early bonanza, production continued intermittently until 1909, when systematic development was begun.

Late in 1911, the southeasterly orebody on No. 4 level was reached. This was typically silicification and enrichment of flat-lying beds of sandstone from narrow and steep fractures; shaly layers in the sandstone seemed to account for vertical localization of the enrichment. The type was like that of enrichment in flat beds in the Black Hills of South Dakota, except that the verticals were fainter and the beds less subject to replacement.

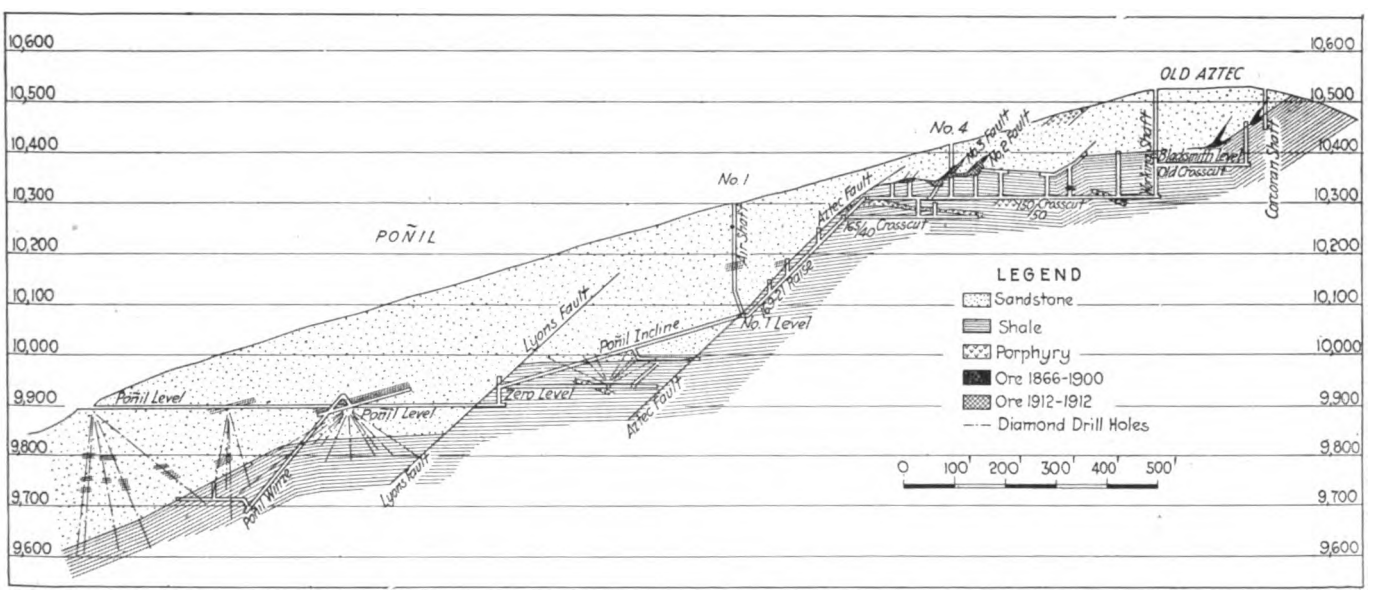


FIG. 1.—NORTHEAST-SOUTHWEST SECTION OF AZTEC GOLD MINE.

In 1914, work opened a bonanza, consisting mainly of altered shale enriched with free gold to a value of $50 to $100 per ton; 80 to 90 per cent. of the gold could be amalgamated and another 5 to 10 per cent., with a little pyrite, was readily caught on a Wilfley table. Although this new orebody was only 500 ft. distant from the old workings, its discovery, by downward prospecting along the contact, would have been delayed by the presence of folds and water-bearing fissures in the intervening barren ground. Subsequent development of this orebody has failed to find the slightest

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continuity with any other ore, and it shows no indication at the surface.

From 1912 to 1920, the mine produced $1,680,718 in bullion, varying from 856 to 889 fineness in gold and 105 to 142 in silver, and $243,079 in concentrates. Shortly after the discovery of the bonanza, the cost of producing gold was as low as $2 per ounce, but in 1919 it rose to $13.50 because of the large amount of timbering required and other operating difficulties. L. C. Graton studied the district, in 1905, for the Geological Survey. In 1916, Edward H. Perry and Augustus Locke reported on the geological conditions at the mine. In 1918, O. H. Hershey made a study of the faulting systems and the ore occurrence. This paper, in addition to recording the observations of the authors, has drawn freely from the written reports of these engineers.

### Structural Geology and Types of Ore Deposits

The original plane of division between the sandstone series and the Montana shale, in places, remains in its original condition, but generally there has been slipping of the rigid sandstone over the soft shale, producing at the top a thin gouge or selvage of 6 to 8 in. of soft crushed shale. Where there has been no actual displacement, that is cutting across of the beds, the contact is regarded as original. Two main periods of faulting are recognized. The first period produced a group of faults of relatively small displacement. While they fault the sandstone, they do not penetrate deep into the underlying shales, but curve to low dips and practically follow the original contact. The second period contains two notable faults of large displacement, called the Aztec and the Lyons fault. The former dips northeastward from 20° to 45°, generally about 35°. Nearly everywhere it has a thick, soft gouge under a hard sandstone roof. The shales under it have been partly crushed to a depth of several feet. In places the disturbed zone contains large fragments of sandstone under the main gouge. The displacement on the plane of the Aztec fault has been about 550 ft. The Lyons fault, as exposed in the Poñil workings, is accompanied by a black gouge and dips northeastward at 35°. It is a normal fault and appears to have a displacement of 450 feet.

Mr. Hershey distinguishes three types of ore deposits, probably formed at three distinct periods. The first is the so-called "shale ore." This is remarkable for its high gold content, whereas contact metamorphic ore deposits usually carry gold in relatively small quantities. A somewhat similar deposit appears to occur at the Ajax mine on the southwestern slope of Mt. Baldy. There the gold is distributed through a dark, heavy, finely granular rock, consisting of nearly colorless pyroxene, amphibole, epidote, magnetite, a little zoisite, scapolite, and specularite.

The second type of mineralization is that accompanying faults Nos. 2 and 3. Its essential minerals are calcite and pyrite. The ore occurs in seams and bunches scattered through a zone of broken ground accompanying the fault gouge. Other carbonates, such as rhodochrosite, may be present and probably a little quartz. Much of the pyrite is coarsely crystallized and there may be a small amount of chalcopyrite with it. The gold content runs from $8 to $50. The metal is fine grained and not visible. Where these fault veins lie at low angles, practically coinciding with the shale-ore lenses, the gold content is relatively high. Good ore continues up along the fault into the sandstone but gradually weakens. Fault veins that do not touch shale ore are not likely to carry commercial ore; and if a fault vein is found to carry commercial ore, it may indicate the presence of shale ore somewhere down along the dip.

The third type of deposit is genetically connected with Aztec, Lyons, and other faults of that system. It occurs almost exclusively in sandstone and its most characteristic mineral is chalcopyrite. The gold content is relatively low, and free gold is rarely or never visible. Movement along the fault fractured the relatively brittle sandstone, forming little fissures in which the solutions circulated. The resulting mineralized zones vary from a few inches to many feet in thickness.

The orebody at the extreme northwest that was commercially important seems to be of a different type from those described. It was extremely high-grade ore having the characteristics of contact metamorphism. It lay just between the contact of shale with overlying sandstone partly altered to quartzite, and though seemingly a part of neither, it extended a short distance upward along the steep, small fractures, fading away into the sandstone. Beside masses of coarse and fine native gold, this ore contained quartz, limonite, garnet, pyroxene, and other silicates, a little pyrite and chalcopyrite and always an appreciable amount of bismuth telluride.

### Mining and Milling

Timbering was by square sets, where the ground was heavy, or soft; and by posts or stulls, where it was hard. At times, waste from development served in large part to fill the sets, but frequently waste raises into the overlying sandstone were necessary; these served also to prospect the sandstone: they never found ore. Much of the ground was heavy, requiring careful timbering. Some of the best ore was overlaid by material that required spiling before the ore could be drilled and blasted. Timbering was by far the largest single item of expense in the extraction of the ore, though the cost of timber was reduced by the operation of a sawmill, a few miles from the mine.

The mill is a ten-stamp amalgamation and concentration combination and by it a recovery of 85.81 per cent. has been obtained in later years. Water for power was available during one month in the spring of

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the year. Upon development of a considerable supply of ore and need for power expansion, the semi-Diesel type engine was selected and Muncie units 30- to 80-hp. were placed in the mill to furnish power for all purposes.

### Costs

On a basis of 30 tons, daily, mined and milled during the years 1918–1920, inclusive, the following costs prevailed.

| | |
|---|---|
| Mining | $4.91 per ton |
| Milling and marketing | 3.54 per ton |
| General | 1.62 per ton |

The total cost of power was $0.0396 per hp.-hr. Fuel oil cost $0.151 per gal. and lubricating oil, $0.967. Fuel oil was used at the rate of 0.708 lb. per hp.-hr. and lubricating oil, 0.041. Trucking 16 mi. the round trip, with practically no back haul, cost $6.86 per ton of freight hauled. The mine is 2500 ft. higher than the railroad.

During the years 1918–1921, inclusive, the cost of mine development, including direct and indirect charges, was $15.89 per ft. over 9883 ft. of work. Of this amount, $7.59 was the cost of explosives, labor of breaking ground, mucking and placing timbers. Diamond drilling 18,276 ft. cost a total of $4.59 per ft., distributed as follows:

| | |
|---|---|
| Direct charges: | |
| Drilling, only | $3.10 |
| Pipe lines and stations | 0.37 |
| Power | 0.66 |
| Water | 0.12 |
| | $4.25 |
| Indirect charges: | |
| Assaying, surveying, sampling and supervision | 0.34 |
| Total cost | $4.59 |

The shortest hole was 40 ft. and the longest 748 ft. An average length of 237 ft. was obtained in 77 holes drilled.

## Metal-mine Ventilation in the Southwest

By Chas. A. Mitke, Bisbee, Ariz.

AFTER describing ventilation systems and their need, especially in deep mines containing high sulfide ores and in mines where caving systems of mining are used, the paper deals with allaying rock dust, and the relation of mining methods to ventilation systems.

In the Southwest, mechanical ventilation of metal mines has been receiving consideration for many years. Thirteen copper-mining companies, with an aggregate tonnage, when operating at approximately 50,000 tons a day, have installed mechanical ventilating systems in their mines. All these mines are within a radius of 200 miles, the largest copper-producing area in the world.

The capacities of mechanical ventilating installations in these mines range from 100,000 to 300,000 cu. ft. of air per minute, depending on the size of the mine, character of the workings, tonnage produced, etc. The latter varies from 300 to 20,000 tons per day. The mines include both high- and low-grade deposits, the greatest depth of the former, at present, being approximately 2500 ft.; and of the latter, 1200 ft. The volumes of air at present being coursed through the mines are from 60,000 up to 225,000 cu. ft. of air per minute, which, in their relation to the underground working force, range from 200 to 800 cu. ft. of air per man, per minute. While not to be taken as criteria, these figures are indicative of the character of the ventilation furnished.

The operators in the Southwest have long realized that efficient ventilation goes hand in hand with low operating costs, principally through the large saving effected in the use of compressed air and the higher efficiency displayed by the men.

### Ventilation Systems

Every large mine is ventilated by a primary and secondary ventilating system. By the *primary ventilating system* is meant the use of a limited number of large units, advantageously located, to ventilate as large an area of the mine as possible. This should approximate 70 to 100 per cent. of the mine workings. The air, in many cases, is drawn down through large concrete shafts, which constitute the main intakes, and are fireproof and have a smooth surface.

The *secondary ventilating system*, consisting of compressed-air jets, booster fans, and small portable blowers with ventilating pipe (some of which are mounted on trucks), is not brought into use until all the possibilities of the primary system have been entirely exhausted.

Ventilating systems for mines in which sulfide orebodies exist, especially if the sulfide is comparatively soft, oxidizes rapidly, and caves readily when stoped, should always have sufficient capacity to remove the additional heat generated from this source, also to take care of emergencies. By such provision, mine fires may be averted or speedily controlled.

During recent years, the introduction of the caving systems have brought new problems in ventilation. When it is considered that in such mines shots are fired as frequently as one every minute (and sometimes oftener), also that every shot pulverizes a certain amount of rock, producing a large quantity of very fine dust, which rises simultaneously and moves with the powder smoke, the necessity for a most efficient ventilating system becomes evident.

In such mines, it is not so much the reduction of excessive temperatures, or high relative humidities, as it is the removal of the smoke and gas produced by blasting, and the fine dust created through continuous mining operations, that is of prime importance. In

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order to remove all the fine dust, smoke, and gas within a few minutes after each blast, without at the same time interfering with mining operations, powerful, flexible, ventilating systems have been worked out and installed, and are being improved from time to time. In some places, the exhaust system has been used; in others, only the pressure system is practicable.

In mines operated by the caving methods, the workings do not have the permanency that exists in higher grade mines worked by square-set, or cut-and-fill methods. The fact that the surface is constantly moving and that a certain number of mine openings are rapidly being caved and closed while others are being opened, necessitates a most flexible system of ventilation. The utilizing of incline raises for ventilation, manways, and supply raises in stopes, as well as for the drawing of ore, provides a most economical and efficient method of ventilating the workings. While ore is being passed through certain raises, others remain open for ventilating purposes, and vice versa. As these incline raises are caved and closed by stoping operations, additional ones are driven in the development work, and by utilizing these, the ventilation always keeps abreast of the stoping.

## Dust Prevention Methods

The South African Miners Phthisis Commission, in its general report, 1916, covering the subject of "silicosis," or "miners phthisis," caused by the inhalation of minute particles of silica, and other insoluble dust, in mine air, stated that: "In mining, it is not the coarse particles, but the fine impalpable dust which is the source of danger, and which, in consequence of the arduous nature of the work in an overheated atmosphere, is drawn by the miner into the recesses of the lungs, owing to the deeper breaths he is obliged to take."

In 1916, efforts were being made to solve the dust problem in both high- and low-grade mines in Arizona, it being realized that for such purposes a combination of ventilation and humidification was necessary, also that such ventilation must be far more intensive than the volumes required merely for the reduction of the ordinary mine temperatures and relative humidities. One of the problems in this connection was the temperature and relative humidity of surface air. In these copper-producing districts, the surface temperatures range from approximately 15° F. (in the winter) to 120° F. (in the summer), while the relative humidity ranges from approximately 35 per cent. (in winter) to 10 per cent. (in summer), with the exception of brief periods during the rainy season. A large volume of air, approximately 200,000 cu. ft. per min., would therefore have a very drying effect upon mine workings, thus facilitating the formation of dust.

If general humidification of the mine air is employed, the relative humidity must approximate the saturation point to obtain results; this should keep the sides and floors of tunnels and drifts moist and prevent a large part of the dust that has already settled from rising. There remains, however, the dust created through drilling and blasting operations, which, if allowed to rise, floats in the mine air and, in most mines, never gets an opportunity to settle. The South African Miners Phthisis Commission (1919) found that in perfectly still air, dust particles 5 microns ($\frac{1}{5000}$ in.) in diameter, took 20 min. to fall through a height of 6 ft., and it took 8 hr. for particles of 1 micron ($\frac{1}{25000}$ in.) in diameter to be deposited.

The detrimental effects of high humidity, when not accompanied by a corresponding air velocity, on the health and efficiency of workers, is too well known to be discussed here; the higher the humidity is raised, the more intensive the ventilation must be.

Water blasts in large stopes appear to be impracticable, because the surface exposed is too large for one blast to cover thoroughly, and a series of blasts would complicate matters. However, in very small square-set stopes and in dead ends, water blasts generally may be used to advantage. Their installation on grizzly levels, in mines worked by the caving systems, may also prove advantageous, provided only a limited amount of water is used; if too much water is employed, the excess will run down through the grizzlies, making the ore sticky and difficult to draw through the chutes. The number of water blasts that can be used underground is limited by the amount of compressed air that they consume. Water drifters are in common use. Water stopers have been tried out with varying success.

The kata-thermometer is used in taking readings in these mines, in order to measure the efficiency of the ventilation. This instrument is an invention of Dr. Leonard Hill of London, the eminent physiologist. As a result of his researches, Doctor Hill found that:

"The quality of freshness of air is due to its cooling power on the body and that, on the contrary, oppressiveness of ordinary atmospheres is due, not to deficiency of oxygen, or excess of carbon dioxide and organic toxins, but to heat stagnation."

## Relation of Mining Method to Ventilating System

An important consideration, which is seldom realized, is the close relationship between the mining method for extracting the ore and the system of ventilation. Having worked out and supervised the installation of ventilating systems for sixteen large metal mines, it has been the writer's experience that the stoping method should first be thoroughly understood before an efficient system of ventilation can be planned. By first carefully studying the mining methods, changes necessary for improvement in the ventilation may also increase the efficiency of the mining method.

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# Personal Notes and Biographies

**Edwin Ludlow** has gone to Muskogee, Okla., and plans to be in the Southwest for several months.

**Harry Wilten,** who has been in the Belgian Congo with the Union Minière du Haut Katanga, is returning to Chicago, Ill.

**Raymond K. Bowden** has been appointed instructor in metallurgy at the Carnegie Institute of Technology, Pittsburgh, Pa.

**Edwin S. Wheeler,** recently with the International Nickel Co., has become eastern sales representative for the Wheeling Bronze Casting Co. of Wheeling, W. Va.

**Elwood S. Moore** has resigned as dean of the School of Mines, Pennsylvania State College, to go to the University of Toronto, Canada, as professor of economic geology.

**Hugh M. Henton** assumed the duties of assistant professor of mining and metallurgy in the School of Mines and Geology at the State College of Washington, in September.

**Charles T. Bragg,** recently works manager of the Michigan Smelting & Refining Co., Detroit, is now president and general manager of the Michigan Valve & Foundry Co. in the same city.

**Justice F. Grugan** and **Thomas Donnelly** have organized the Mines and Petroleum Registry, Inc., a clearing house for mining and petroleum properties. The office is at 135 Broadway, New York.

**F. B. Tough,** United States supervisor of oil and gas operations on leased public lands, has been appointed chief petroleum technologist of the Bureau of Mines, to succeed A. W. Ambrose.

**D. A. Vazquez** has resigned his position with the Compañia Azucarera Oriente, to accept the position of chief engineer with the Compañia Azucarera Antilla, Central Bagnaños, Cueto, Oriente, Cuba.

**Earl R. McMillan,** recently in charge of coal-washing investigations in the Pacific Northwest states and Alaska for the U. S. Bureau of Mines, has joined George Watkin Evans as consulting engineer specializing in coal.

**Donald M. Liddell,** of the firm Weld & Liddell, consulting engineers, has been made secretary of the Mining and Metallurgical Society of America to fill the uncompleted term of B. B. Gottsberger, who has become professor of mining at Yale.

**C. E. Van Barneveld** was transferred, on July 1, from the superintendency of the Southwest station of the Bureau of Mines to the superintendency of the Mississippi Valley station. His headquarters are in the Chamber of Commerce Building, St. Louis, Missouri.

**Charles McKnight, Jr.** recently joined the Development and Research Dept. of the International Nickel Co., New York City, to undertake development work in connection with alloy steels. Mr. McKnight was formerly works manager of the Carbon Steel Company.

**James F. Kemp,** professor at Columbia University, says, of his trip to the Northern Seas: "Almost all summer I have been away on a cruise to Iceland, the North Cape, the fjords and southern Scandinavia, a most delightful voyage in a big ship chartered by Raymond & Whitcomb. There is nothing like a steamer chair for a complete change and loafing spell. Our shore leaves put us in touch with some of the, geologically, most interesting parts of the world."

**A. W. Ambrose,** chief petroleum technologist of the, U. S. Bureau of Mines, has been appointed assistant director of the Bureau, to fill the vacancy caused by the resignation of E. A. Holbrook to become dean of the mining school at Pennsylvania State College. Mr. Ambrose is a graduate of Stanford University. He was appointed petroleum technologist with the Bureau of Mines in 1917, served as superintendent of the petroleum experiment station at Bartlesville, Okla., from February to November, 1920, and was then made chief petroleum technologist of the Bureau.

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## Franklin O. Pierce

FRANKLIN O. PIERCE, long associated with Doctor Raymond at Institute headquarters, died at his home in Woodhaven, N. Y., on Aug. 28.

Mr. Pierce was an employee of the Institute from the year 1906 to the year 1915, and for the greater part of the time was assistant editor of the BULLETIN and TRANSACTIONS of the Institute. Doctor Raymond placed much reliance on Mr. Pierce's painstaking and careful proofreading and Mr. Pierce took pride in the accuracy of the editorial work entrusted to him.

Members and employees who met him during his years at the Institute will hear with regret of his death.

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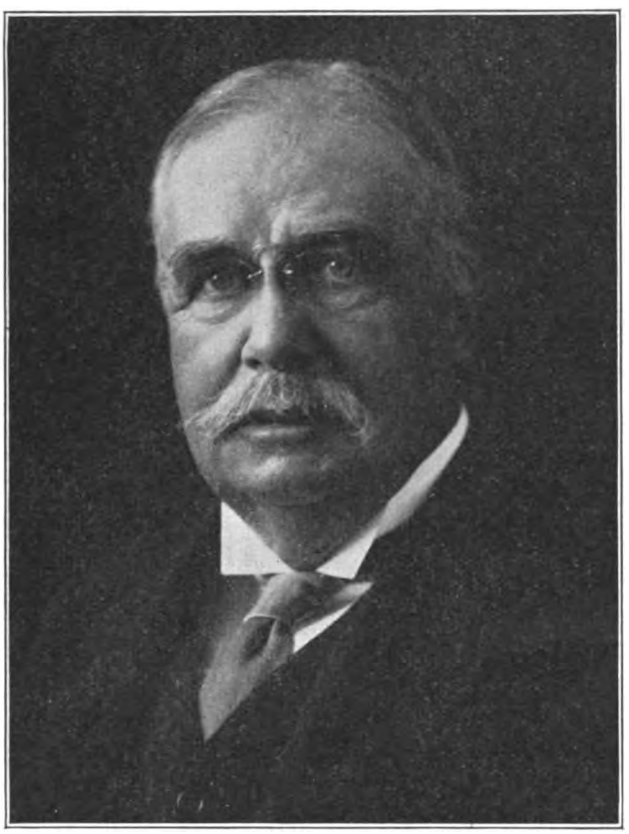
## Gardner F. Williams

GARDNER F. WILLIAMS, authority on diamond mining, died at San Francisco, Cal., on Aug. 22, after an illness of nearly a year.

Mr. Williams, who was in his eighty-first year, was born in Saginaw, Mich. He was graduated from the University of California in 1865, and afterward took



GARDNER F. WILLIAMS.

a course at the Freiberg Mining Academy, in Saxony. He was awarded the degree of LL. D. by the University of California in 1910, and Doctor of Engineering by the University of Michigan in 1917.

Beginning in 1870, Mr. Williams spent two years as assistant assayer at the United States Mint in San Francisco. He successfully developed several mines in the West, and then went to South Africa. He was in charge of the gold mines in northern Transvaal during the years 1884–85, and later was engineer for the Exploration Company, Ltd., of London, in South Africa.

In 1887, he became general manager of DeBeers Company, which later became DeBeers Consolidated Mines, Ltd., organized by the late Cecil Rhodes and others, which produced 95 per cent. of the diamond yield of the world. He was in South Africa during the Boer war.

Mr. Williams was the author of several books, the one entitled "The Diamond Mines of South Africa" being especially well known.

He was a life member of the American Institute of Mining and Metallurgical Engineers, which he joined in 1886, and was also a member of the National Geographic Society; the Institution of Mining and Metallurgy, London; British Association for the Advancement of Science, and other scientific bodies. He was a member of the Metropolitan and Chevy Chase clubs of Washington and the Pacific Union Club of San Francisco.

When Mr. Williams returned from South Africa, he established his residence at Washington, D. C., where he took an active interest in civic affairs.

In 1871, Mr. Williams married Fanny Locke, of Oakland, Cal. Mrs. Williams died in 1911. A son, Alpheus Fuller Williams, now general manager of DeBeers Consolidated Mines, Ltd., of South Africa, and three daughters, Mrs. William Wallace Mein of New York City, Mrs. Frederick DeCourcy Faust of Washington, D. C., and Mrs. Monroe Eyre Pinckard of San Francisco, Cal., survive him.

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## Guy H. Cox

GUY H. COX, geologist for the Josey Oil Co. of Okmulgee, Okla., was killed in an automobile accident on the night of Aug. 19. Doctor Cox was professor of geology and mineralogy at the Missouri School of Mines and Metallurgy from 1909 to 1920. His death was a great shock to the faculty and alumni of that institution, with which he had been so closely identified for so many years.

Doctor Cox graduated from Northwestern University in 1905 with the degree of Bachelor of Arts. He took graduate work at the University of Wisconsin and received the degree of Ph. D. in 1911 He also received the degree of E. M. from the Missouri School of Mines and Metallurgy. He was a member of the honorary fraternities, Sigma Psi and Tau Beta Pi.

Doctor Cox published a number of geological papers, and was the senior author of "Field Methods in Petroleum Geology," by Cox, Dake and Muilenberg, a standard text on that subject.

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## F. S. Peabody

FRANCIS STUYVESANT PEABODY, a son of Francis B. Peabody and a nephew of Nathaniel Baker, the first Democratic governor of New Hampshire, was born in Chicago in 1859. In 1881 he graduated from Yale and two years later he established an unpretentious retail coal business in Chicago which, through the application of his remarkable business ability, became one of the great coal-producing and distributing companies in the United States.

In 1917, when the industries of the country were operating on a war-time basis and the demand for coal reached unprecedented figures, Mr. Peabody was called to Washington to head a committee working under the

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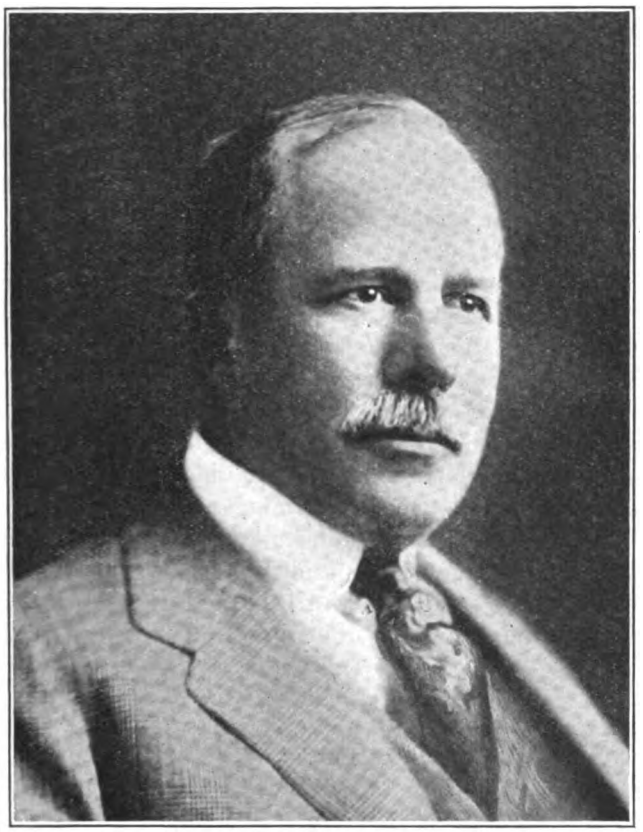
Council for National Defense, to increase the production of coal and facilitate its distribution. Later, when a Federal Fuel Administrator was appointed, Mr. Peabody was given charge of a committee to administer the war emergency act regulating the storage and sale of explosives.



FRANCIS S. PEABODY.

He was a generous contributor to all worthy charities and took a special interest in the Salvation Army. In recognition of this interest and support, he was awarded the degree of Doctor of Humane Letters, by the Temple University of Philadelphia, in 1921. He was decorated by the King of Italy for his efforts during the war.

Mr. Peabody's hobby was the raising of thoroughbred stock on his farm at Hinsdale, Ill., near Chicago. His chickens have taken first prizes for many years at the big poultry shows and his hunters and jumpers have been in the foremost ranks at national stock shows and at society horse shows. His farm was the scene of many hunting parties, and it was during a hunt that a sudden stroke caused his death, on Aug. 27.

At his funeral there were notable men with whom he had been associated in business and pleasure for many years, but also there were hundreds from the humbler walks of life who mourned in his death the loss of a true friend.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Aug. 15 to Sept. 15, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1914 | ASANO, K. | Sept. 17, 1921 |
| 1912 | COX, GUY H | August 19, 1922 |
| 1879 | HOWE, FRANK P | August 24, 1922 |
| 1916 | PEABODY, F. S. | August 27, 1922 |
| 1897 | WAGONER, LUTHER | July 1, 1922 |
| 1886 | WILLIAMS, GARDNER F. | August 21, 1922 |
| 1885 | WURGLER, A. | |

# Institute Affairs

## Function of the Milling Committee

THE understanding has not been clear, in every case, what work is being done by the Committee on Milling Methods of the American Institute of Mining and Metallurgical Engineers. The committee depends somewhat upon prevailing understanding and general coöperation for the accomplishment of its purposes. A few words of explanation are needed, accordingly, to bring these matters to the attention of those who should profit from the activities of the committee.

Through the work of this committee, in past years, there have come to general attention many distinct needs that are felt in milling practice. They are needs that have to do not so much with shortcomings existing in practice as with difficulties that lie in the way of everybody who is attempting to improve his practice. It is such improvement that leads to the general welfare. The difficulties that are encountered are not intended as obstructions. They are not placed in the way, by anybody. They are, rather, due to inertia and the inability of mining and milling practice, unprompted, to remove common obstacles that have fallen into the public trail. The urgency requires to be pointed out, and the obligations made clear. Some of the tasks, urgent for the betterment of milling prac-

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tice, seem properly not to fall to anyone as a special obligation. Many of these come most fittingly within the province of this committee. In doing this work, the committee is prompted by a single motive looking to the betterment of industry and the advancement of public welfare. The high character of our American practice, in which our methods and appliances, our improvements and our engineers have lead the way and extended our interests into every corner of the world, does not support and sustain itself, unordered, but requires the distinct attention of far-seeing groups of men prepared to act together for the cause that has made the men and the industry that supports them.

The work at present being done by this committee is in the standardization of certain milling practices, such as the screen-sizing test, the determination of prevailing opinion as to certain mill terms, the assistance to the Institute in securing the presentation of papers of the kind now most needed for the benefit of the industry, and the outlining of the needs that prevail in milling practice where the assistance of the committee is required for the service, where the support of the Government should be recommended, and where coöperative effort within the field of the practice itself requires suggestion by the committee or guidance.

The particular work called for is not performed by any other agency that now exists. The great mining and metallurgical organizations existing as agencies of public good and acting on the highest motives are powerless to reach the specific divisions of their field except through the agencies of their subordinate committees, such as the Committee on Milling Methods. Universities and schools, equipped with facilities and staff for coping with problems of this nature have other functions to perform. Organized for the creation and dissemination of knowledge, they are not equipped with the time, machinery, nor funds to serve as an agency in which the prime motive is economic rather than purely educational. Universities can not be called upon to render the special service that is here required of our Committee on Milling Methods.

The United States Bureau of Mines, which is organized for constructive work under the support of the Government, is helpful to metallurgical industry wherever and however its high service is found to be most required. The claim of our milling practice upon the Bureau of Mines is an urgent one, but in its appeal for public support and assistance it must take its rank with many other branches of the mining industry.

The Committee on Pulverization of the National Research Council now is united with this Committee on Milling Methods. The joint committee is in a position to act in close harmony with the Committee on Standardization. The joint committee purposes to be responsive to all other bodies or organizations having similar aims, and to act coöperatively with them in so far as lies within its power.

With the high outlook and the purely generous motive, and with the purpose of facilitating and assisting in the advancement of milling practice in every way possible, the committee is dedicating its service and receiving marked support. Highly valued counsel and assistance has come from many individuals, and substantial support from such institutions as the University of California, the Massachusetts Institute of Technology and the United States Bureau of Mines.

The committee, in the past year, conceived the idea of establishing headquarters in Boston, of conducting its activities with the varied interests through a secretary devoting his entire attention to the coöperative work based upon the high aims that have been stated, and of establishing, through its headquarters, a helpful central agency to promote contact between the sources of knowledge within its field and to assist individuals, or established interests, that are seeking the betterment of their practices.

We should see in this work of the Committee on Milling Methods a constructive purpose, designed to benefit the milling industry, and, with it, all who are engaged in it. There are many men, both within the American Institute of Mining and Metallurgical Engineers and outside its membership, who will be given the privilege of aiding in the uplifting effort that is being made, and who will be called upon to say a word or lend a hand in the work that is being done.

ERNEST A. HERSAM
*Secretary of the Milling Committee.*

## The Institute Badge

THE Institute has no *official* badge, and yet the cross hammers alone or with the letters A. I. M. E. are so well known to the mining fraternity as emblems of membership in the Institute that they have become the recognized, if not the official, insignia of the organization.

The Civil, the Mechanical and the Electrical Engineers all have their official badges, and they are worn with more frequency than are the hammers of the Mining Engineers. There is no particular reason for this, unless it is that the members of the other Founder Societies have grown accustomed to wearing them, finding that they often serve the purpose of a card of introduction.

The world is large, and the ten thousand members of the Institute when scattered over it are not easily identified. We travel as much as other engineers, possibly more. We meet and pass without speaking simply because we do not know that we are face to face with other engineers with whom we may have much in common. Our little badge has often supplied the opening for a meeting or a conversation, not only to while away the hours of a tedious railway journey, but actually to bring together men who have profited by the silent introduction. Our badges have brought

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about one of the important things for which the Institute was established—the meeting of kindred spirits and the exchange of technical information.

The badge serves still another purpose, which may be less well defined but of no less importance. To many of us it is the emblem of the Institute, as the flag is the emblem of our country. Just what we mean by an emblem depends entirely on our own mental attitude toward the thing for which it stands. If we regard membership in the Institute as a creditable thing, a privilege, or an honor, we look upon its symbol with respect, and as a wearer, we are ready to maintain the dignity, the honor and the good name of our organization even to the extent of fighting for it. If we have little interest in our membership, an emblem will mean little or nothing, and we will not wear one.

So to our good members we would say "Do not forget your cross hammers when you go where men are gathered; they will break the ice of a cool reception. Do not forget to wear them when you alone will see them; they will break down any wall of indifference that may tend to grow up in your own mind."

F. F. SHARPLESS.

## Federated Report on Muscle Shoals

THROUGH the Executive Board of the American Engineering Council at its session in Boston on Sept. 8, the Federated American Engineering Societies adopted a resolution authorizing the appointment of a committee of leading engineers to study thoroughly every phase of the Muscle Shoals problem in order to clear away what was described as a " hopeless muddle."

In a spirited speech supporting the resolution, Philip N. Moore denounced the proposal of Henry Ford, citing figures tending to show that acceptance of this proposal of the Government would be a calamity. Stating what he called the elements of the proposition and declaring that "committees of Congress have obscured the situation," Mr. Moore continued:

> Enthusiastic politicians, hopeful idealists, bargain-demanding farmers, and success-hunting manufacturers ask the expenditure of great sums of public money, in order that it may be leased to a private individual for 100 years, upon terms which, as estimated by a distinguished civilian engineer, if charged with 4 per cent. compound interest, and the rental payments credited by same will at expiration have cost the Government $1,278,000,000 more than the receipts from the lessor.
>
> The elements of this enterprise have never been laid clearly before the public by a body of competent engineers who could be universally recognized as having no interest other than the truth.

The president of the Federated, Dean Mortimer E. Cooley of the University of Michigan, was directed to appoint a committee of disinterested, distinguished and skilful engineers, to be selected by a special committee of the Executive Board, and approved by the Committee on Procedure, for the purpose of making a thorough study of the assembled facts regarding the Muscle Shoals proposition, this committee to serve without compensation.

## Closing Date for Papers

PAPERS for the annual meeting of the Institute in February, 1923, must be in the hands of the Secretary before Dec. 1, 1922, in order to insure publication and distribution before the meeting, which is the only means of getting the proper amount of discussion of papers and the problems they contain.

It not only contributes to the success of the meeting but helps to reduce the pressure on the Secretary's office, and to reduce costs, when papers are received early. So that with sufficient notice it is to the advantage of everybody, including the author, to get these papers in on time.

## Second Non-ferrous Lecture

THE second annual lecture of the Institute of Metals Division will be delivered by Dr. Walter Rosenhain, of the National Physical Laboratory, Great Britain. The subject will be some theoretical phase of non-ferrous metallurgy. During his visit in this country, Doctor Rosenhain will deliver lectures at Massachusetts Institute of Technology, Yale, Columbia, Case School of Applied Science, and Franklin Institute.

## Federated Drawing New License Law for Engineers

AT THE meeting of the Executive Board of the Federated American Engineering Societies in Boston, Sept. 8 and 9, Gardner S. Williams, of Ann Arbor, Mich., and W. B. Powell, of Buffalo, were appointed to draft a bill calling for the registration of engineers. This bill will incorporate the recommendations of American Engineering Council's Committee on Legislation of Engineers, published in the July issue of MINING AND METALLURGY.

## Once a Mining Man, Always a Mining Man

ONE of the older members who usually attends the meetings of the Institute sent a letter recently regretting that he could not go to the San Francisco meeting because neither of his sons could be persuaded to accompany him. In acknowledging the receipt of this letter, the Secretary intimated that the sons had not been brought up properly or they would have been ready to fulfil their father's wish. To this the father replied in the following letter which will be appreciated by many members:

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I note that you think I have failed in the youth of my two sons to use enough of the stick on them to compel them to respond to my suggestions.

When I was a boy in Scotland, a cane was used very liberally on me. If I couldn't answer my questions (in the shorter catechism) I was licked at school with a leather strap. If I couldn't recite the four or five verses of Scripture that my father allotted me to recite on Sunday afternoon, then I got no dinner until I could, and sometimes a licking besides.

What was the effect? I early acquired a dislike for St. Paul, whose metaphysical assertions on foreordination and predestination were beyond my apprehension. St. Paul said, "There is, therefore, now no condemnation to them which are in Christ Jesus, who walk not after the flesh, but after the Spirit." On the other hand, I liked John, who said, "A new commandment I give unto you, that ye love one another; as I have loved you, ye also love one another. By this shall all men know that ye are my disciples, if ye have love one to another."

Now instead of using the stick, as you suggest, I tried to appeal to my children's intelligence, with this warning, "When I advance you money and you lose it, then I will charge the loss up against you in my will so that your share of my estate will be much less than you might otherwise expect." For instance, to my mining-engineer son I said that I have already lost considerable amounts on his unprofitable investments, and that I have written my will, leaving him the mining stock as part of his share of my estate.

Mining losses, however, have not lessened my high opinion of the mining profession. When traveling with members of that profession, I have often found them the prince of good fellows. They laugh at spilt milk, leaving me to envy their good nature, especially when they assure me that it is all in the day's work.

If I had life to begin over again, looking back on my experiences, I think, for opportunities of profit and esteem in society, I would choose the profession of mining engineer as one in which, with little capital, a man can start in business for himself and, by using good judgment, make money for his stockholders, some for himself, and friends all around.

In this way he will not only secure the respect of others but he can sit on the porch on a summer evening with his wife and children and respect himself, knowing that he has not connived by his wits to enrich himself while beggaring his neighbor. His labor on Mother Earth has produced from her bosom that which enriches all mankind and impoverishes none.

# Local Sections and Affiliations

## Local Section Meetings

**Boston.**—Meets first Monday of each winter month.

**Columbia.**—Holds four sessions during year. Annual meeting in September or October.

**New York.**—Meets first Wednesday after first Tuesday of each month. At the meeting to be held on the evening of Oct. 4, at the Machinery Club, the speakers will be S. Reading Bertron and Edgar Rickard, and the subject of discussion will be "Russia—Present and Future." Mr. Rickard, director general of the American Relief Administration, recently returned from Russia.

**San Francisco.**—Meets second Tuesday of each month.

## Columbia Section

THE Columbia Section held a meeting at the Davenport Hotel, Spokane, on Aug. 4, the vice-chairman, F. M. Smith, presiding.

U. C. Tainton outlined his process for treating the Coeur d'Alene ores, and described the methods employed at Bully Hill, Cal.

## Affiliated Student Societies

**Columbia University.**—The Senior class of the School of Mines completed its summer work in mining on Sept. 1. The surveying was done during the first two weeks of July at Roxbury, Conn., in an abandoned iron mine leased by the university. Ernest H. Dickinson was in charge of the party.

After completing this work, the class, under the direction of Prof. Robert M. Raymond, made an extensive trip through the Copper Country, with Houghton as headquarters. Beginning at the northern end of Keweenaw Point, the men studied the extensive and modern development work which is being done at the Seneca mine under the superintendence of W. J. Uren, then observed the actual mining operations at the Mohawk and Ahmeek mines, and, at the Champion mine, on the Copper Range, made a detailed study of the method of "dry wall" mining and the conditions that make such a method practical and economical. At the Champion mine, General Manager W. H. Schacht, Superintendent A. Mendelsohn and Mine Captain Jose aided the class in every way possible.

The well equipped machine and blacksmith shops, the power plant, the four-stage compressor unit, and the vacuum heating system connected with the hoisting engines, impressed the men with the great importance of mechanical engineering in the mining industry.

After a week at the Champion mine and a day at the mills in Freda, the students went to the Menominee Range. Here they were the guests of General Manager William Kelly, of the Vulcan mine, and noted in detail the room-and-pillar system, the square-set timbering, the animal haulage and pumping equipment. A morning was spent at the Chapin mine, Iron Mountain, where the interest lay in the extensive pumping system, made necessary by an inflow through underground streams in the hanging wall of about 5,000,000 gal. of water per 24 hours.

The students in the party were Emile E. Gyss, Robert S. Joyce, Darwin J. Pope, Alfred R. Smith, and Yuan C. Wong.

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# Increase of Membership Department

Total membership as of Sept. 9, 1922, is 10,196

APPLICATIONS FOR MEMBERSHIP.—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.

The following persons have been proposed during the period Aug. 15 to Sept. 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—Frederick J. Bailey,** Washington, D. C.
Present position—1919 to date: Assistant to the Director, U. S. Bureau of Mines.
Proposers: H. Foster Bain, Dorsey A. Lyon, E. A. Holbrook.

**2—George Brown Barbour,** Tientsin, China.
Present position: Professor of Geology, Peiyang University.
Proposers: Arthur C. Terrill, James F. Kemp, R. J. Colony.

**3—Walter Davies Barrington,** New York, N. Y.
Present position: Consulting Sales Engineer, Consolidation Coal Co.
Proposers: Frank Haas, R. E. Righ tmire, A. Stephen Knowles.

**4—Emerson McMillin Butterworth,** Los Angeles, Cal.
Present position—1921 to date: Geologist for Land and Lease Division, Southern California District, Standard Oil Co. of California.
Proposers: Stephen H. Gester, G. C. Gester, E. G. Gaylord.

**5—Frank W. Davis,** Minneapolis, Minn.
Present position: Metallurgist, U. S. Bureau of Mines.
Proposers: W. R. Appleby, F. G. Cottrell, Dorsey A. Lyon.

**6—Samuel Edward Dickey,** Johnstown, Pa.
Present position—1912 to date: President and Chief Engineer, S. E. Dickey & Co.
Proposers: H. M. Chance, Howard N. Eavenson, Newell G. Alford.

**7—Howard T. J. Duffey,** Wilmington, Del.
Present position—1919 to date: Technical Representative, E. I. Du Pont de Nemours & Co.
Proposers: Howard I. Smith, F. W. Hukill, E. T. Lednum.

**8—Richard Bulford Eddy,** Morro Velho, Raposos, E. F. C. B. Minas, Brazil.
Present position—1920 to date: Assistant to Technical Advisory Engineer, St. John Del Rey Mining Co. Ltd.
Proposers: A. G. N. Chalmers.

**9—Silas Lee Gillan,** Los Angeles, Cal.
Present position—1921 to date: Consulting work, Los Angeles, Cal.
Proposers: Burr McWhirt, Wayne Loel, Ralph Arnold.

**10—John DeHuff Gold,** Steubenville, O.
Present position—1921 to date: Chief metallurgist, Weirton Steel Co., Weirton, W. Va.
Proposers: Emil Gathmann, Wilmer E. Breck, Harry E. McDonnell.

**11—Magotsuchi Ito,** Iizuka, Fukuokaken, Japan.
Present position—1902 to date: Mining Engineer, Mitsui Mining Co., Hondo and Yamano Collieries.
Proposers: Takuma Dan, Yoshima Sayeki, T. Makita.

**12—Eldred Arthur Knapp,** Redruth, Cornwall, England.
Present position: Assistant Surveyor, British Controlled Oil Fields.
Proposers: J. McClelland Henderson, P. St. John Dixon, J. Warne Chenhall.

**13—Charles Fowler Lindsay,** Greenwich, Conn.
Present position: President, Milford Electrolytic Iron Co., New York, N. Y.
Proposers: C. P. Perin, Bradley Stoughton, S. M. Marshall.

**14—Baldomero Michaelsen,** Llallagua, Bolivia, S. A.
Present position: Engineer, Compania Estanifera de Llallagua.
Proposers: E. Diaz, J. M. Mitchell, Alexander Grosberg.

**15—Kotaro Morimoto,** Gatozi, Fukuokaken, Japan.
Present position—1908 to date: Mining Engineer, Miike, Yamano and Tagawa Collieries, Mitsui Mining Co.
Proposers: Takuma Dan, Yoshima Sayeki, T. Makita.

**16—Ludovic Mrazec,** Bucuresti, Roumania.
Present position: Secretary General of the Minister of Industry and Commerce.
Proposers: V. R. Garfias, Etienne A. Ritter, N. H. Darton.

**17—William Purviance Tams, Jr.,** Tams, W. Va.
Present position: President and General Manager of Five Coal Companies.
Proposers: J. M. Hicks, R. H. Buchanan, C. D. Dorrance.

**18—Kenichi Sakamoto,** Iizuka, Fukuokaken, Japan.
Present position—1917 to date: Electrical Engineer, Tagawa, Miike and Yamano Collieries, Mitsui Mining Co.
Proposers: Takuma Dan, Yoshima Sayeki, T. Makita.

**19—Taro Tomita,** Iizuka, Fukuokaken, Japan.
Present position—1898 to date: Mining Engineer, Mitsui Mining Co.
Proposers: Takuma Dan, Yoshima Sayeki, T. Makita.

**20—Richard Thomas, Jr.,** Branxton, New South Wales, Australia.
Present position—1911 to date: Manager, Rothbury Collieries.
Proposers: David Atkins, Edwin Ludlow, Thomas H. Leggett.

**21—Sam Tour,** Brooklyn, N. Y.
Present position—1921 to date: Metallurgist, Doehler Die Casting Co.
Proposers: George K. Burgess, William A. Cowan, Paul D. Merica, F. C. Binnall, W. M. Corse.

**22—Jasper Anderson Waggener,** Bauxite, Ark.
Present position: Engineer, American Bauxite Co.
Proposers: John T. Fuller, John A. Fordyce, Harmon Lewis.

**23—John Vivian Wherry,** New Florence, Pa.
Present position: Field Engineer, Columbia Petroleum Co.
Proposers: Tom R. Jones, H. P. De Pencier, James John Denny.

**24—Bert P. Woolridge,** Wallace, Idaho.
Present position: Engineer, Hecla Mining Co.
Proposers: James F. McCarthy, Stanly A. Easton, Charles H. Foreman.

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Associates

**25—Robert Hesketh Coolidge,** Chicago, Ill.
Present position—1920 to date: Supervisor of Inspection and Metallurgy, U. S. Ball Bearing Manufacturing Co.
Proposers: B. H. DeLong, W. P. Sykes, Frank Garratt.

**26—Evan Just,** Chicago, Ill.
Present position: Field Assistant, Production Dept., H. F. Wilcox Oil and Gas Co., Tulsa, Okla.
Proposers: Fred L. Wolf, J. W. Merritt, U. S. Grant.

**27—Robert Carl Matson,** Hancock, Mich.
Present position—1919 to date: Instructor, Civil and Mining Engineering Dept., Michigan College of Mines.
Proposers: F. W. Sperr, J. B. Cunningham, F. W. McNair.

**28—James Elliott Robson,** Cornwall, England.
Present position: Unemployed.
Proposers: P. S. Dixon, J. McClelland Henderson, Joel Allan Battle, Jr.

**29—George Alexander Vincent Russell,** Sheffield, England.
Present position—1921 to date: Works Manager, Savy Bros. Ltd. New Works.
Endorsements: West of Scotland Iron & Steel Institute, The Iron & Steel Institute (London), Cleveland Institute of Engineers.

**30—William Alfred Scarlett,** Butte, Mont.
Present position: Miner, Elm Orlu Mining Co.
Proposers: C. H. Clapp, H. T. Mann, Theodore Simons.

**31—Wesley Burton Stanley,** Amalfi, Antioquia, Colombia, S. A.
Present position—1919 to date: Assistant Manager, La Viborita Mining Co.
Proposers: E. A. Probst, Eric K. Craig, C. J. London.

Junior Associates

**32—E. Taylor Campbell,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, Charles Y. Clayton.

**33—Lorin Alvin Cranson,** Sebastopol, Sonoma Co., Cal.
Student, Stanford University, A. B.
Proposers: W. F. Dietrich, C. F. Tolman, Theodore J. Hoover.

**34—George Godley Harris,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, Charles Y. Clayton.

**35—Peter Mar,** Winnipeg, Manitoba, Canada.
Student, University of Manitoba.
Proposers: J. S. DeLury (Prof. but N. M.) R. C. Wallace (Prof. but N. M.).
Endorsement: The Canadian Institute of Mining and Metallurgy.

Change of Status—Associate to Member

**36—John K. Walsh,** Wilburton, Okla.
Present position—Professor of Mining Engineering, Oklahoma School of Mines.
Proposers: Charles Y. Clayton, M. H. Thornberry, C. R. Forbes.

Change of Status—Junior Associate to Member

**37—Clifton Thompson Armstrong,** Puerto Mexico, Ver., Mexico.
Present position—Engineer, Geological Department, Transcontinental Petroleum Co.
Proposers: Robert Peele, A. F. Main, Robert M. Raymond, Bruce Wade.

# Engineering Societies Library

HARRISON W. CRAVER, Director

The Engineering Societies Library, on the 13th floor of the Engineering Societies Building, 29 West 39th St., New York, contains approximately 150,000 volumes of engineering literature. It is open on week days, excepting holidays, from 9 a.m. to 10 p.m.

The Library offers, on payment for the extra work required, to supply photoprints or translations of articles, make searches for information, prepare lists of references and suggest books on engineering subjects. The cost of searching is $2 an hour. Translations cost $6 and upwards per thousand words. Typewritten copies, $1 a thousand words. Photoprints, 11 by 14 in., cost $0.25.

When the Library contains two copies of a book, one may be borrowed by a member. Transportation costs must be paid by the borrower.

The Library is at the service of every member. Those who cannot visit it may order searches, translations, copies, etc., by mail.

Address correspondence to the Director of the Library, Harrison W. Craver, 29 West 39th St., New York.

**Mine Management.** By Robert Z. Virgin. N. Y., D. Van Nostrand Co., 1922. 109 pp., 5 × 7 in., cloth, $2.

This book is one of a series on related subjects by the same author and all adapted to the vocational education administered by the Federal Board. Mine Management is an excellent little manual, and is obviously written by one who has had years of experience underground. While the author's experience has been chiefly in coal mines, what he writes is well-suited also to metal mining. The book is cast in the form of fifteen lessons, with a series of ten questions at the close of each. Practically all the subjects that affect the relations of the mine management and the men are treated with an excellent understanding and in a spirit which is of the best and which is of such a nature as to foster greatly improved conditions. Today we are dosed *ad nauseam* with "labor," and are half starved as regards our crying need of "work." The two words have come to have totally different meanings, as different as vocal chords and hands, or as hot air and horsepower, whereas the only sure foundation is to have them imply the same thing. Mr. Virgin's little book will operate toward this end and is to be strongly commended to all members of the operating force.

**Industrial Physics; Mechanics.** By L. Raymond Smith. First edition, N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 226 pp., illus., diagrs., 5 × 8 in., cloth, $1.75.

The present trend in education has created a demand for textbooks in which the material presented is closely connected with the every-day life of the student. This volume is an attempt to meet this demand by providing an elementary, practical textbook on mechanics, suitable for use in high schools and vocational schools.

**Iron Ore.** Part 3–5. Issued by Imperial Mineral Resources Bureau. Lond., H. M. Stationery Office, 1922. 6 × 9 in., boards.

In these volumes the Imperial Mineral Resources Bureau of the British Empire presents a concise account of the iron ore industry in various lands, with special reference to present and prospective supplies of ore. Each account is prepared from the most authoritative sources, is accompanied by maps and statistics, and forms a convenient summary of information upon the subject.

**Mechanical Testing.** Vol. 1. By R. G. Batson and J. H. Hyde. N. Y., E. P. Dutton & Co., 1922. (Directly-useful technical series.) 413 pp., plates, illus., diagrs., 6 × 9 in., cloth, $9.

The object of this book is to place before the engineer, manufacturer, and student the conditions governing modern testing, the particulars of standard testing plant equipment and its limitations, and the information necessary to apprise the results obtained at their true values. Volume one is confined to materials of construction.

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**Design of Masonry Structures and Foundations.** By Clement C. Williams. First edition, N. Y. and Lond., McGraw-Hill Book Co., 1922. 555 pp., illus., diagrs., 6 × 9 in., cloth, $5.

Recent analytical and experimental investigations of the properties of masonry materials, the forces to which masonry structures are subjected, and the behavior of such structures have contributed largely to the transformation of masonry design and construction from an art to a science. The extensive use of concrete and the development of reenforced concrete have contributed largely to this end. This scientific understanding of masonry design has widened the use of masonry to include many structures for which other materials were formerly used. In addition, more attention is being paid to elegance, grace and beauty in design.

**Hydraulics with Working Tables.** By E. S. Bellasia. Third edition. N. Y., E. P. Dutton & Co., 1922. 348 pp., tables, illus., 6 × 9 in., cloth, $8.

In this edition the book has been brought thoroughly up to date and subjected to careful and drastic revision. The chief object is, as before, to deal thoroughly with the facts, laws, and principles of hydraulics, and to keep always in view their practical aspects. New discussions on all the most important coefficients are now given and specific recommendations are made. A new set of coefficients for pipes is given.

New matter has been added on weirs and weir-like conditions, on discharge measurement by means of pipe diaphragms, on standing waves, and on the laws governing silting and scour. The book is intended to meet all the requirements both of the student and of the engineer.

**Metallography.** By Cecil H. Desch. Third edition. Lond. and N. Y., Longmans, Green & Co., 1922. 440 pp., plates, diagrs., 5 × 8 in., cloth, $5.

In this work Professor Desch presents an account of the physical and microscopical methods used in the study of metallic alloys, sets forth the conclusions that have been reached, and indicates the directions in which further research is desirable. The literature of the subject has been studied critically and an attempt made to evaluate the various investigations.

For this edition, the text has been thoroughly revised and the important recent work added; the most important changes occur in the chapters on the physical properties of alloys, on corrosion, and on the metallography of iron and steel.

**Mexican Petroleum.** N. Y., Pan American Petroleum & Transport Co., 1922. 300 pp., illus., map, ports., 5 × 8 in., fabrikoid.

An attractive publication, the primary purpose of which is to furnish information about the development of the Pan American Petroleum & Transport Company and its chief subsidiaries. The history of the company is related and its oil lands in Mexico and California are described. A detailed account of its equipment for transporting oil by land and sea, its facilities for supplying steamers with fuel oil at American and British ports, and an account of its refineries are given. A general chapter on the geographical distribution of petroleum and various tables complete the book.

**Petroleum; Where and How to Find It.** By Anthony Blum. Chicago, Modern Mining Books Publishing Co.; Lond., D. Appleton & Co., 1922. 367 pp., port., 5 × 7 in., cloth.

The aim of this book, according to the author, is to present in non-technical language that information concerning the oil industry which is wanted by laymen interested in oil properties. The situation of the petroleum industry and its future prospects, and the methods of winning and marketing petroleum are described, and advice given to would-be investors. The author draws upon an experience of over thirty years in western states, in mining metals and petroleum.

**Petroleum Possibilities of Certain Anticlines in Southeastern Idaho.** By V. R. D. Kirkham. Bulletin 4. 36 pp., 9 illus.

**Geology and Ore Deposits of Alturas Quadrangle, Blaine Co., Idaho.** By S. M. Ballard. Bulletin 5. 36 pp., 18 illus.

These publications are issued by the Bureau of Mines and Geology of the State of Idaho in coöperation with the University of Idaho, Moscow, Idaho.

**Standard Handbook for Electrical Engineers.** Frank F. Fowler, editor-in-chief. Fifth edition, revised. N. Y. and Lond., McGraw-Hill Book Co., 1922. 2137 pp., diagrs., 4 × 7 in., fabrikoid. $6.

As the last edition of this popular handbook appeared seven years ago, this revision will be widely welcomed. No change has been made in the general arrangement and make-up, but each section has been thoroughly revised by the substitution of modern material and data for such as has become obsolete. Substantial changes have been made in almost every section, a few have been rewritten, and new material has been added to others.

**World Metric Standardization.** Compiled by Aubrey Drury. San Francisco, World Metric Standardization Council, 1922. 524 pp., ports., 6 × 9 in., cloth, $5.

A comprehensive survey of the arguments advanced in favor of the adoption of the metric system in commerce. The testimony of proponents of the system has been collected from a wide range of sources and summarized in convenient form for consultation. A bibliography of over fifty pages is included.

# Employment Service Bureau

**Under joint management of the national societies of Civil, Mining, Mechanical and Electrical Engineers.**

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

The Employment Service Bureau sends a weekly bulletin, giving lists of positions vacant, to secretaries of local sections and also to secretaries of affiliated student societies.

## Engineers Available

**No person other than a member of one of the four Founder Societies will be registered with the Employment Bureau under this heading.**

**Superintendent.**—Mining and milling, metallics and non-metallics, surface and underground. Seventeen years experience. Age 37. IM–1634.

**Chemist-metallurgist.**—1921 graduate. One year of practical work in die-casting concern. Specialized in aluminum, zinc, copper, and their alloys. Has had charge of production and research on die-casting alloys. Will go anywhere. IM–1635.

**Mining Engineer.**—Graduate. Twelve years in coal and metal mining, non-ferrous metallurgy, and chemical industry, in the United States and abroad. Operating as well as research and geological work. Well posted on foreign, industrial and economic problems. IM–1636.

**Mining and Metallurgical Engineer.**—Graduate. Eight years experience in copper mining and metallurgy. Experienced executive. Desires position as instructor in university with opportunity to take up advanced study in metallurgy. Specialty for teaching, higher mathematics. Will consider any opening. IM–1637.

**Metallurgical Engineer.**—Graduate. Experience in electro-metallurgical research and production of ferro-alloys in the electric furnace. Immediately available for technical, commercial, or teaching position offering opportunities. Single. IM–1638.

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**Mining Engineer.**—Graduate. Eight years experience. Speaks Spanish. Seeking permanent connection. Available immediately. IM–1639.

**Mining Engineer.**—Graduate. Sixteen years experience as manager and superintendent in western States, Alaska and Mexico. Thorough knowledge of all phases of mine operation. Best references. IM–1640.

**Metallurgical Engineer.**—Experience in ferrous and non-ferrous metallurgy; also business and sales experience; open for position in any of these lines. IM–1641.

**Mill Superintendent or Research Metallurgist.**—Seven years experience as operator and director of research on complex ores. Speaks Spanish fluently. Desires position as superintendent or assistant superintendent of concentrating plant, or as metallurgist in charge of research. Single. IM–1642.

**Mining Engineer.**—Eleven years experience as mine surveyor, mine foreman and superintendent. Speaks and writes Spanish. Seeks position as superintendent or assistant; western states or Mexico preferred. Interview El Paso or Los Angeles. Age 33. Unmarried. IM–1643.

**Research Geologist.**—Editorial and statistical experience. Wants position in geological or statistical department of oil company. IM–1644.

**Mining Engineer.**—1921 graduate desires to get experience. Will work anywhere. Willing to work at anything. IM–1645.

**Mining Engineer.**—Graduate. Two and one half years experience in oil geology, mine examination and operation and general construction inspection, open for engagement anywhere. Age 27; single. IM–1646.

**Mining Engineer.**—Seeks position as oil geologist or exploration engineer. Tropical and South American experience. Age 27. Single. IM–1647.

**Mining and Mechanical Engineer.**—Specialist in mechanical and electrical engineering applied to mining and in the reduction of power and fuel costs. Six years as master mechanic, four years as chief engineer and two years as assistant superintendent. Technical graduate. Age 42. Married. Employed at present but desires change. IM–1648.

**Engineer.**—Graduate. Three years experience coal and ore prospecting, diamond drilling, property and mine surveys, coal-mine plant construction, and general mine office work. Age 24. IM–1649.

**Mining Engineer.**—Eight years in bituminous coal mining, covering reconnaissance, construction, development. Desires position as chief engineer or superintendent. Age 30. Married. IM–1650.

**Executive Engineer** with sales, advertising and marketing experience. Technical work required. Knowledge of structural, highway, steam and electric railway engineering; valuation, correspondence, reports, economics, general business and industry and physical metallurgy. Age 38. Professional practice and Chicago location preferred. IM–1651.

**Petroleum Geologist and Chemist.**—Graduate of European university, Ph. D. degree. Seven years experience in Europe and U. S. A. Open for geological field work or research laboratory. Age 35. Married. IM–1652.

## Positions Open

**Persons applying for any of the following positions will please place their names, addresses and initials of the society to which they belong (A. S. C. E., A. I. M. E., A. S. M. E. or A. I. E. E.) on the outside of the envelopes containing the applications.**

**Associate Editor** for engineering journal. General qualifications: age 28 to 35; engineering education, preferably mechanical; shop experience, preferably as an executive; some editorial experience or its equivalent; personality, the ability to mix. Application by letter. New York City. V–2117.

**Expert Accountant** for mining property in Nevada, including a large construction job just being initiated. Single man preferred. Application by letter. V–2094.

**Mining Engineer,** recent graduate for underground work. Application by letter. Pennsylvania. V–2061.

**Rodmen** (3).—Long Island, N. Y. V–2398.

**Chemical Engineer** who has had experience in erecting naphtalene plants. Application by letter. New York City. V–1627.

**Physics Instructor.**—Must have had teaching experience and expect to continue in profession, or have had good engineering training and engineering experience, but plans to stay in teaching. Takes at least two years to train even a good man to work. Application by letter. Northeast. V–1755.

**Sales Engineer** to sell the capacity of gray iron and malleable iron foundries. Must have thorough knowledge of foundry practice and have experience selling this type of product. Will entail traveling, principally in New England and New York State. Application by letter. V–1828.

**Chief Engineer** for manufacturers of conveying machinery. Chief engineer or chief draftsman, well experienced in layout construction and details of conveying machinery of various types. Capable of taking complete charge of drafting department. Unusual opportunity for right man. Personal interview will be arranged. Application by letter. Missouri. V–1856.

**Superintendent** of foundry laboratory in large university in middle west. Fine opportunity for technically trained man with foundry experience who desires to enter teaching profession. Application by letter. V–1881.

**Engineer** having experience in design of industrial electric furnaces, or experience in application of industrial electric furnaces. Application by letter. Pennsylvania. V–1894.

**Mining Engineer** with broad mechanical experience for diatomaceous earth plant in northwest United States. Age 30–40. Must be willing to do drafting and layout of equipment; also to install and operate plant. Milling experience essential. Application by letter. Oregon. V–1896.

**Chief Draftsmen** for company manufacturing air compressors, 12-in. stroke and shorter; steam and power pumps, 12-in stroke and shorter. Application by letter. Illinois. V–1910..

**Instructor** in mathematics including descriptive geometry and surveying. Appointment for three years. Recent graduate of some good engineering school preferred. Appointment by letter. Syria. V–1929.

**Sales Engineer** to work on commission basis, to secure gray iron casting business. Application by letter. New York State. V–1949.

**Engineer,** not over 35, as instructor in descriptive geometry. Should have not less than three years experience as mechanical draftsman with some reputable manufacturing concern. Application by letter. Georgia. V–1975.

**Estimator,** designer preferably with experience in consulting engineers office on power generating equipment. Must be capable of making plant survey to determine power requirements for extensive new installations. Application by letter. Ohio. V–1981.

**Metallurgists** on steel castings for bottle molds in electric foundry. Application by letter. Ohio. V–1998.

**Mining Engineers** (2) 24 to 30 years old, single, for alluvial diamond mining. Application by letter. Africa. V–2060.

**Mining Engineer,** two to three years experience, for underground work. Application by letter. Pennsylvania. V–2062.

**Sales Engineers.**—Three men to possess the qualifications necessary to apply gas-fired steam boilers in industries and for house heating; one for application of gas-fired appliances for heat treatment of metals; and one to possess qualifications for application of gas to gas-burning equipment to large bake ovens. New York. V–2110.

**Mill Man** familiar with the Lane slow-speed chilean mill operating on gold ores where amalgamation and concentration

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follow. Application by letter giving full particulars. New Mexico. V–2143.

**Sales Engineer,** with about four years practical experience. Company manufactures manganese steel casting used by mining, cement, etc. industries. Also frogs, switches, and crossings for special track work. Application by letter stating age, education and experience. Traveling. V–2153.

**Salesman** with knowledge of combustion for heating and power plant, to sell fuel economy apparatus, designed to burn buckwheat coal and screenings in plants where larger and more expensive coal is used. Application in person. Commission basis. Philadelphia, Pa. V–2191.

**Superintendent** of foil plant with rolling-mill experience. Application by letter. New York City. V–2197.

**Chemical Engineer or Physicist** for lime research work. Application by letter. V–2198.

**Coal, Oil and Natural-gas Engineers** for report and research work in government departments. Application by letter. Washington, D. C. V–2215.

**Engineer** to teach pattern making and foundry work to second-year engineering students. Should be engineering-college graduate and should have had successful practical foundry experience. Must be American citizen and have usual qualifications expected of teacher. Application by letter. Nine months. Texas. V–2221.

**Sales Engineer** experienced air compressors and pneumatic tools, to act as department manager. Application in person. New York. V–2227.

**Draftsman** for detail work on coal-crushing and pulverizing machinery. College graduate with one or two years experience. Application in person. V–2240.

**Assistant Professor of Metallurgy.**—Courses covering heat treatment of carbon and alloy steel, metallurgy of iron and steel, and principles of iron founding. Should be college graduate with teaching experience. Application by letter. Michigan. V–2243.

**Chief Draftsman** on chemical plant layout work who has also had experiences on maintenance work. Application by letter. New York. V–2253.

**Engineer** with experience in hydraulic mining, as well as turbo-power plant operation. Application by letter. Georgia. V–2273.

**Agents** to handle sale and installation of Newport rotary oil burner, an oil-burner burning efficiently 11°B. Mexican oil for high- and low-pressure steam and hot-water boilers. Exclusive territory granted. Application by letter. Headquarters, Rhode Island. V–2274.

**Instructor** in general engineering drawing, including descriptive geometry. Only graduates of recognized technical schools considered. Teaching experience desirable but not essential. One or two years of practical engineering experience necessary. Application by letter. Illinois. V–2276.

**Superintendent** to take full charge of mining property that will ship to the smelter and is capable of enlarging its ore reserves. Should have about 10 years active experience, with executive ability. Salary reasonable. British Columbia. V–2286.

**Assayer** with gold, wet copper, and lead experience. Spanish desirable but not essential. Single man. Application by letter. Peru. V–2295.

**Metallurgist** experienced in automobile manufacture, capable of handling metallurgical department, including laboratory work testing, etc. Application by letter. Ohio. V–2310.

**Mining Engineer** with gold and silver mining experience. Married man preferred. Altitude 3500 ft. House and car furnished. Application by letter. Arizona. V–2335.

**Assistant to Chief Engineer,** in charge of entire engineering department and have some knowledge of metal refining and ability to get along with men. Application by letter. New Jersey. V–2360.

**Instructor** in ore dressing and coal washing, mine surveying, mine ventilation, electrical applications in mining and possibly mine design. Illinois. V–2378. (Ask for application blank.)

**Examiner** for coal, tin and silver. Must have been in high altitude in South America. Spanish essential. Application by letter. V–2390.

**Salesman.**—Recent chemical or mining graduate to learn sales work with a metallurgical concern. New York City and vicinity. V–2396.

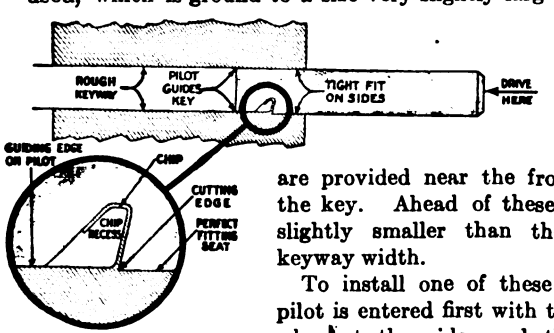
**Instructor** in metallurgy, elementary mining and preparatory mathematics. Nine months teaching. Engineering graduate with some teaching experience and metallurgical practice if possible. Application by letter. New Mexico. V–2429.

# Industrial News and Developments

**Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.**

## Keytite Self-fitting Keys

IN the new Keytite self-fitting keys, a tough chisel stock is used, which is ground to a size very slightly larger than the nominal keyway width. A cutting edge and chip recess are provided near the front end of the key. Ahead of these is a pilot slightly smaller than the nominal keyway width.




To install one of these keys, the pilot is entered first with the cutting edge at the side, and the key is driven home with an ordinary machinist's hammer or with a sledge, depending on the size of the key. The cutting edge sizes the keyways to make a tight fit between the body of the key and the keyways. The illustration shows the method of applying the keys.

In the larger sizes, cutting edges are sometimes provided on both sides and at the top. Gib keys and other modifications can be furnished as required, all with this self-fitting advantage which saves the cost of hand fitting and which always provides that the key will be a tight fit in the keyways.

Smith & Serrell, Newark, N. J., are the sales agents.

## John A. Roebling's Sons Company Adopts Group Life Insurance and Pensions

EMPLOYEES of the John A. Roebling's Sons Company, Trenton, N. J., are protected by group life insurance and pension plans. The insurance is graded according to length of

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service, all employees more than one year and less than two years with the company to receive $500, increasing $100 each additional year of service until the maximum of $1500 is reached for 11 years of service and over. The insurance benefits will be payable to the beneficiary named by the employee, or, in the event of his becoming totally and permanently disabled, will be paid to him.

The pension plan contemplates retirement at the age of 60 for men and 55 for women, for those who have served 20 years or more. Other plans cover various other contingencies, including cases of total disability arising from non-occupational injuries and illnesses. The amount of pension is determined by multiplying 1 per cent. of the average annual pay during the 10 years preceding retirement by each year of service. A minimum of $25 per month and a maximum of $250 a month will apply, except in cases where the pension is being paid in the cases of total disability referred to, where the minimum may be less than $25 per month.

## Industrial Notes

**Hercules Powder Co.** announces a reduction of its selling prices of high explosives and B. blasting powder, effective on Sept. 18.

**Sullivan Machinery Co.,** following completion of its new plant at Michigan City, about Feb. 1, will remove its Chicago works, utilizing equipment and later disposing of buildings. A tract of 125 acres has been acquired for new plant, buildings to include foundry, machine shop, assembling plant, etc., and estimated to cost about $1,000,000, including additional equipment. Office headquarters will be maintained in Chicago.

**Concordia Electric Co.** has received approval from the U. S. Bureau of Mines covering equipment approved under Schedule 10A. The eqiupment is approved for safety and adequacy for service as follows:

For hand lamp service, when equipped with a white glass dome.

For trip lamp service, when equipped with a ruby glass dome and when used with special holder which was tested with the lamp and is furnished by the manufacturer.

**E. I. du Pont de Nemours & Co.** announces that, effective Sept. 1, 1922, the Smokeless Powder Division will be separated from the Explosives Department and will be operated as an independent industrial department, known as the Smokeless Powder Department, under Vice-President A. Felix du Pont as general manager.

The Ashburn Works of the du Pont company, near Hannibal, Mo., will resume the manufacture of high explosives early in September. This plant was closed down about a year ago, but improvement in business conditions, resulting in increased demands for high explosives, makes it necessary to resume operations.

**E. I. Du Pont de Nemours & Co.** also announces a reduction in prices of high explosives and blasting powders, effective Sept. 18.

**C. J. Tagliabue Mfg. Co.,** Brooklyn, N. Y., exhibited some of its representative products at the Chemical Exposition.

Among them were the Tag automatic temperature-humidity controller; Tag automatic controllers of temperature, pressure, vacuum, time, liquid-level and condensation-discharge; Tag industrial thermometers, chemical thermometers and hydrometers; the improved form of Tag recording thermometer; Tag-Mono automatic gas analyzing instruments; and Tag oil testing instruments.

L. C. Irwin, general manager, T. Dougherty, sales manager, V. Wichum, engineer, R. M. Wilhelm, technical adviser, F. D. Harger and A. Traudt, engineers, represented the company at the booth.

## Trade Catalogs

**Research Corpn.,** 25 W. 43 St., New York.—Bulletin 4-BL, on Standard Unit Construction, Cottrell Electrical Precipitation Process.

**Braun Corpn.,** 363 High St., Los Angeles, Cal.—Bulletin S202, on the Herman Screening Ball Mill.

**Pennsylvania Pump & Compressor Co.,** Easton, Pa.—Bulletin 202, describing double-suction single-stage centrifugal pumps, also giving engineering data.

**Jeffrey Mfg. Co.,** Columbus, Ohio.—Catalog 368, on Swing Hammer Pulverizers. Concise description, and data, also shop illustrations and installation views.

**Roller-Smith Co.,** 233 Broadway, New York.—Bulletin 250, on Portable Direct Current Galvanometers, Types LGD and KGD.

**McIntosh & Seymour Corpn.,** Auburn, N. Y.—Bulletin illustrating McIntosh & Seymour Diesel Oil Engines, for direct connection to alternating-current or direct-current generators; also for use with pumps, mills or other machinery.

**National Iron Co.,** Duluth Minn.—Fully illustrated, attractively printed pamphlet on Underground Shoveling, dealing particularly with the Hoar underground shovel

**Maurice A. Knight,** Akron, Ohio.—Fifty-page catalog on Acid-proof Chemical Stoneware made in America.

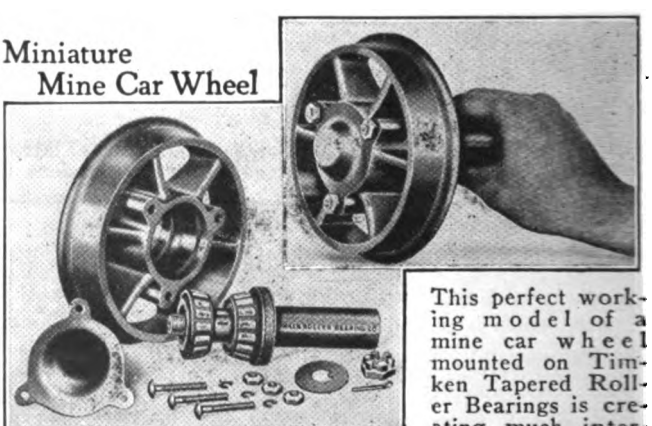
**Kelly Valve Co.,** Muskegon, Mich.—Booklet describing the Kelly Self-grinding Valve.

**Voland & Sons, Inc.,** New Rochelle, N. Y.—Catalog H, of Assay and Analytical Pulp and Bullion Balances, Metric Precision Weights and Balance Accessories.

**Abbé Engineering Co.,** 50 Church St., New York.—Bulletin 19, on Pulverizing, Grinding and Mixing Machinery. Gives specific data regarding this machinery and about the testing laboratory maintained for use of prospective purchasers.

**Oliver-Sherwood Co.,** San Francisco, Cal.—Bulletin on Cutless Bearings. This describes bearings that have an inner surface of grooved Olivite rubber, points out the special advantages of these bearings, and answers objections.

Bulletin 3, on Olivite Acid Pumps. This tells about the substance called Olivite, and describes its use in pumps.




This perfect working model of a mine car wheel mounted on Timken Tapered Roller Bearings is creating much interest among mine car manufacturers and mine operators. Although only a few inches in diameter, this miniature wheel shows to a nicety the application of the tapered roller bearing to mine car wheels; and demonstrates the principles which make it possible for the tapered roller bearing to eliminate the greater part of the maintenance cost of mine cars.

These miniature models, which are already in the hands of many leading mine car manufacturers, are to be exhibited at the Coal and Industrial Exposition, at Huntington, West Virginia; and the National Exposition of Mines and Mining Equipment at Cleveland.

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# MINING AND METALLURGY

NOVEMBER 1922


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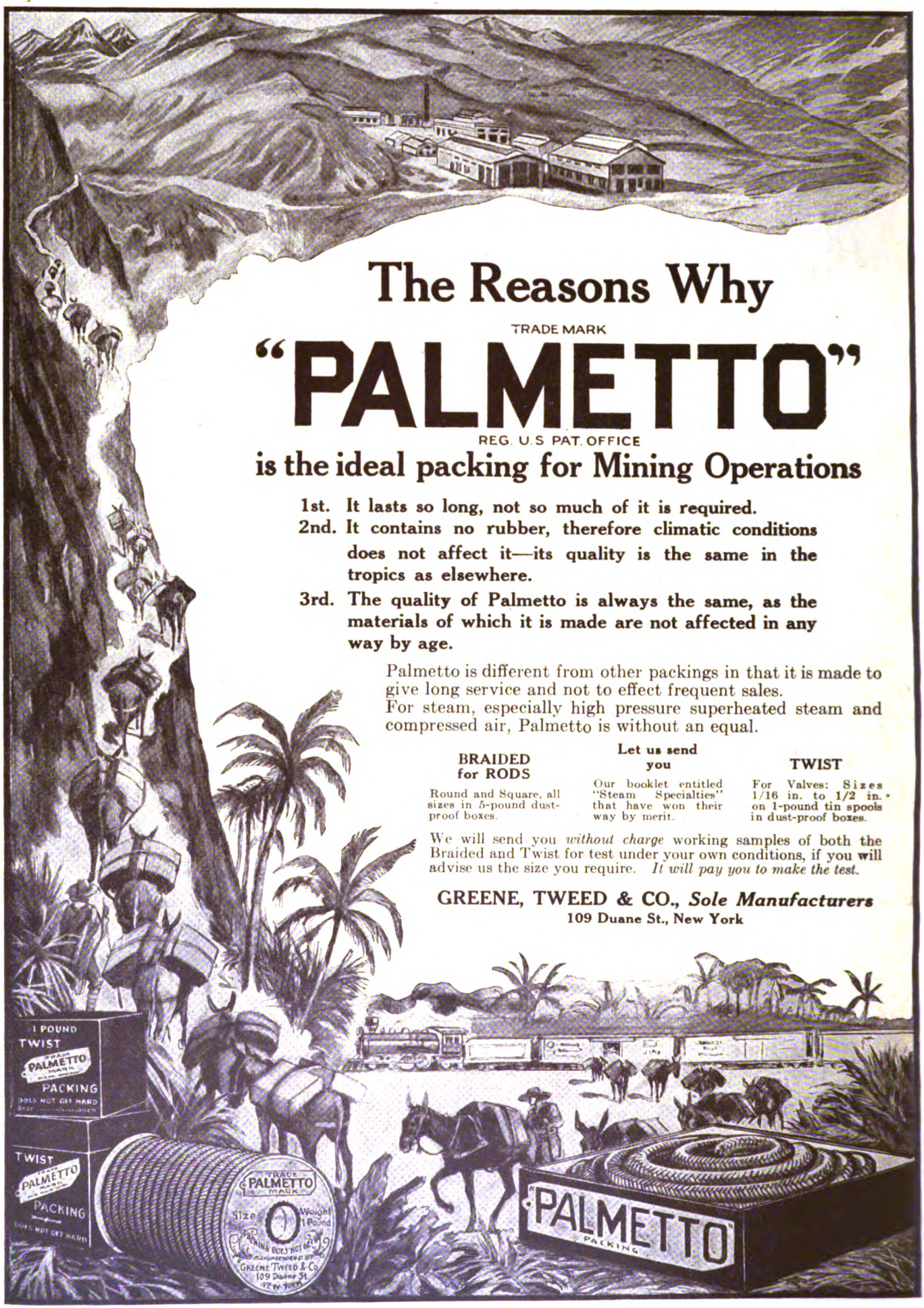

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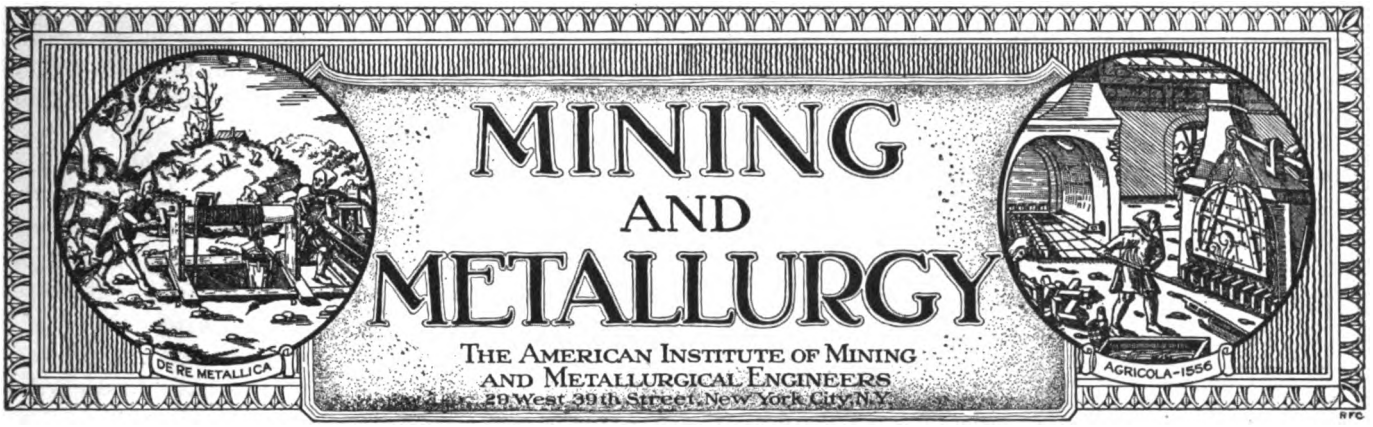


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## EDITORIAL

### The Need for Leadership

THE most conspicuous state of mind among the classes of people of the United States at the present time is expressed in the phrase "Discontent among the farmers." In the words of an eminent political newspaper correspondent, recently making a survey of sentiment in the corn-growing states

> The farmers are sullen, and grow more so every day. If you should ask of a hundred farmers the reason for their discontent, they would all answer in practically the same words: "Low prices for what we have to sell; high prices for what we have to buy."

What is characterized as being a radical, "almost bolshevist," movement was rampant in Iowa. Anyone who has read my writings is aware that socialism and bolshevism are anathema to me, but we all know that the farmers are not socialistic by instinct or nature, although now and then they allow socialistic experiments to be foisted upon them, as in North Dakota. I find, however, that the present exponent of radicalism in Iowa is against high taxes, against the ship subsidy project and against the conditions that make for high railway rates. If this be radicalism, and if conservatism means high tariffs, ship subsidies and all the other economic evils that are being perpetrated, I am in favor of such "radicalism."

The Iowa exponent denounced the policy of general deflation, but that is not surprising. Whenever the farmer becomes the victim of low prices for his products and high prices for the things he must buy, and moreover is bothered by his debts, his mind becomes financial, and he begins to think in terms of cheap money. Like the average man, floundering amidst the intricacies of economics and finance, his thoughts, if they be not completely vague, turn around among all kinds of erroneous ideas and rank heresies.

In the industrial parts of the country, there is a high degree of satisfaction and the enjoyment of luxuries including the luxury of leisure, and especially has this



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been so since the settlement of the strikes, although Samuel Gompers writes that "Labor has repeatedly made the charge that there exists a conspiracy to destroy the trade union movement." Intelligent people know that Mr. Gompers is talking merely for effect, and that there is in fact no such concerted movement, although there ought to be. In the meanwhile, we read in the newspapers items like the following:

Leslie L. Lanker, of Summerville, Pa., drew $247 in pay for 11 days work as miner in the pits of the Oak Valley Coal Co. He worked a regular 8-hr. shift and was paid at the rate of $1 per ton of coal loaded.

Mike Rancher, who works in a coal mine at Rockwood, Pa., Friday drew $291.45 for two weeks' work, 8 hr. each day.

It appears that Lanker averaged about 22.5 tons of coal per eight hours or 2.8 tons per hour—Rancher did a little better—24.3 tons per eight hours, or about 3 tons per hour. Each of them did an honest day's work, but nothing extraordinary in so far as physical capacity is concerned.

It was one of the same class of workers as Mr. Lanker and Mr. Rancher who was addressed by a newspaper correspondent when in the act of buying a new, expensive automobile, and being congratulated upon his prosperity and being interrogated about his unfortunate, or fortunate, obligation to pay income tax, replied contemptuously: "What ya givin' me? I don't pay no income tax. I'm a workin' man, I am."

Among the pictures that we can see in this kaleidoscope there are others. I have heard working people in New England deploring that they must now pay $20 per ton for anthracite coal, shivering as they talk about it, for the New England winters are cold, and there was the implication that there would not be very much coal coming to these people at that price.

Such little pictures, which after all illustrate just what the people are talking about, are translatable into economic language and into revelations of the factors that are operating beneath the surface, and that ought to be understood.

The Western farmer gets but low prices, even lower than the pre-war, for his products, owing to the impoverishment of Europe, which curtails the demand for his exportable surplus which demand makes the market. No tariff on agricultural products and no political formula can alter this condition.

On the other hand, the things that he has to buy are high, at least 1.5 times the pre-war, because town labor, including the railway workers, has been able so far to maintain greatly enhanced wages, refusing to participate in the deflation that inevitably overtook the farmers and other people, and will in the end enforce itself upon all labor, willy-nilly.

When the farmer ships a carload of hogs to Chicago and finds that the produce of his hard work, which knows no eight-hour day, has vanished into nothingness, it is not the railway companies and the packing companies that have appropriated it, but it is the railway men and every other class of laboring man who has participated in the transportation, manufacturing and distribution of the food products, right down the line to the ultimate consumer.

Similarly, when the farmer buys his clothing at 1.5 times the pre-war price, probably for shoddy goods at that—and when the New England scrubwoman has to pay at the rate of $20 per ton for half a ton of anthracite—it is not the woolen manufacturer nor the anthracite coal-mining company that extort the price, but it is the miners and mill men, and again the railway men, the carters and all others who have to do with the handling of the goods.

For this situation also there is no political panacea. The thoughts of the Western farmers turning erroneously to money jugglery dwell moreover upon new governmental activities, such as more regulation and even renewed operation of the railways. Those would be the worst things that could happen, as Mr. McAdoo showed us thoroughly.

The aristocrats of labor, having come into possession of an undue part of the produce of the farmers and other people, buy profusely of automobiles and exercise a great deal of choice about their work, refusing to do anything but what is agreeable and being able to have their way by virtue of getting enough wherewith to live out of relatively little work.

All of this means simply the hogging by comparatively few people of an unduly large share of a diminished national production. In other words, it is unbalanced distribution of the produce of industry. This can not continue indefinitely unless the American people have discovered a way of making something out of nothing. The charlatans who are now talking to the farmers do so in words that are capable of translation into the representation that such a discovery has been made and the farmers are beguiled into believing them. Of course, the governmental operation of railways and other services, the erection of tariff barriers, the blowing of credit bubbles, etc., mean nothing else, for none of those things contributes to increased production, which can only be accomplished by hard work, invention, good management, and thrift. Dissension between the agricultural workers and the town workers, as we see it now, was bound to come. Even could it be foreseen that the animosity of the agricultural workers would in ignorance be misdirected, and would be aimed not against the labor unions, but against what is called "Wall Street." The farmer-labor movements that are promoted in some parts of the country are a joyous idea for the labor unions but for the farmer they are about as sensible as the lamb lying down with the lion.

I think that the United States is about the last country in the world where socialism and communism can make headway, although there are plenty of propagandists for those terrible things who (generally for selfish purposes) aim to promote them and play upon the ignorant. However, Americans are too individual-

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istic and too capitalistic, by great majority, to get into either of those boats. The only real danger is in letting themselves be guided into quagmires and letting silly experiments be tried upon them by charlatans and disingenuous prophets.

I feel great sympathy with the discontent that prevails. I look upon the confusion in minds as being very human. Radicalism in the United States means to me dissatisfaction with the state of affairs and ignorant, foolish gropings to make things better. Conservation seems to mean the avoiding of some foolish things and the perpetration of others conceived as panaceas. Coxey is the prototype of the leadership of one party; old Doctor Swamproot of the other. The people, in their pre-election discussions, while I am writing this seem to be expressing their own helpless recognition of the futility of the politicians and their grudge against the politicians of all types who ought to have led them and did not.

The country is hungry for strong, sound leadership, of the kind that has no selfish thought for offices, party power, or the next election—leadership that has the knowledge to understand conditions and the courage to tell things truly, no matter how unpalatable they may be. Such leadership would teach that the war did not add to our national wealth, but that it produced great dislocations among our economic conditions and great unbalance in the distribution of the produce of our industry. The old balance must be restored as nearly and as swiftly as possible. Deflation, instead of a thing to be resented, should be speeded along. The farmer, having suffered this first, can not be helped by anybody blowing bubbles, but he can be helped by deflating labor generally. Wall Street, meaning collective business, has no interest except to see everybody, farmers and labor alike, prosperous so that there will be goods to be bought and sold and freight to be carried. It is town labor that stands in the way of farmers and white-collar classes alike. If the U. S. Labor Board and other governmental agencies are an obstacle to labor deflation abolish them. Appeal not to the government for any further regulation of business for the hand of the government is the touch of death. On the contrary, curtail the government's own activities—not merely the Federal but also the state, county and municipal managements—and thus reduce taxes, which are being abated but little, if any at all, and *ipso facto* are opposing deflation. We may need many public improvements, but ought to forego them if we can not afford them. We must help Europe and must buy goods from her in order to sell to her.

These are some of the truths that real leaders would preach, but above everything else they would proclaim that the war did not do anything to raise permanently our scale of living, that the entrance of some people upon the enjoyment of such luxuries as never before was paid for by the patriotic by mortgaging their principal, and that the present is a time that calls for hard work in production, economy in living, and thrift in saving. It is leadership along these lines, and these only, that will remove the present discontent and promote the general welfare. If anybody should not like it—and the labor unions will not—the sooner they be brushed away, without any further catering to them, the better it will be.

Since I wrote the above paragraphs, the U. S. Railway Labor Board surprised everybody by declaring that the principle of "the living wage if carried to its legitimate conclusion would wreck every railroad in the United States, and if extended to other industries, would carry them into Communistic ruin." The phrase "living wage" was termed as "a bit of mellifluous phraseology, well calculated to deceive the unthinking." The Board continued, as follows:

> That it would be wise and practical to undertake to establish an arbitrary standard of living for several millions of persons is not apparent. That the desires and requirements of all men are equal and alike is not correct, and that any committee of experts could set up an average living standard upon which a wage scale could be practically based has not been demonstrated anywhere.
>
> That standards of living are gradually improving in this country is undoubtedly true, and this is as it should be. There is no member of the Labor Board who does not profoundly desire improved living conditions for common labor, but it is our belief that this movement must be continued along lines indicated by human experience and that it cannot be consummated in the twinkling of an eye by artificial expedients.

Finally, the Board declared flatly that in the last analysis the establishment of a standard of living for any single class would mean that the public would pay for the increased wages and that most of it would come from workers in the other industries. This is economic common sense. That the U. S. Labor Board should become an exponent of it affords ground for hope.

W. R. Ingalls.

## Fact-finding Commission for the Coal Industry

THE announcement of the personnel of the Fact-finding Commission to investigate the coal industry, appointed by President Harding, contains the names of John Hays Hammond, who is chairman of the commission, and George Otis Smith, director of the United States Geological Survey. These two names alone relieve the mining industry of the dread that the commission to be appointed would bring in a more or less nebulous report which would be rejected by both the operators and the miners and leave the industry just where it was before.

The other members of the commission are ex-Vice President Marshall, distinguished for his practical good sense and integrity; a sound lawyer, Judge Samuel Alschuler; a public-spirited editor, Clark Howell; Dr. Edward T. Devine, a social worker of national reputation, and Charles T. Neill, manager of the bureau of information of the Southeastern railways.

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This is an eminent body of men and the President and the people of the country are to be congratulated on their selection. No less fortunate are the mine operators and the miners themselves. The former are assured of an intelligent investigation of the intricate technical details of the mining business by two outstanding mining engineers, whose integrity is as great as their ability.

The appointment of Dr. George Otis Smith on this commission is a happy one for another reason. The Geological Survey is the greatest repository of facts and figures of the coal-mining industry in existence today and no commission could function without the aid of his department. Acting as a commissioner, he will be freed from the restraint imposed upon him as Director of the Survey. This efficient machinery already functioning in the gathering of facts and statistics will very much expedite the work of the commission. Should these two outstanding members of our profession return findings which are surprising to the public and unpalatable to the coal operators, we shall at least be sure that there has been no thimble rigging which would accelerate our progress towards economic disaster in the country's most needful industry.

The commission is also to inquire into and make recommendations regarding the standardization of the mines, with the possible closing of those unable to maintain that standard, standardization of the cost of living and living conditions among miners and the advisability of legislation having to do with government or private ownership, regulation and control. These are either minor considerations or vital subjects so camouflaged as to conceal the ugly features of the case. The commission should determine and plainly state whether a coal strike never lasts longer than the operators' stock piles. It should, and we have no doubt it will, fearlessly expose the conditions that have nearly split the National Coal Association into two camps, divided by the Potomac and Ohio Rivers, one of which, being unionized, wants to be relieved from the onerous restriction of dictatorial labor unions, and the other, being free from such restrictions and enjoying the large commercial differential as a result, which desires to maintain conditions pretty much as they are. A pronouncement on these points will take away from the labor leaders the argument that appeals most strongly to the mob psychology.

The character of this report and the way it is received by the heads of the labor unions will also determine whether their leaders are really working for a just peace in the industry or whether they are playing politics for the continuance of their own position and power.

We anticipate a report from this Commission that will be a classic and one that will mark an epoch, not only in the coal-mining industry but in industry at large. The credit for this, while being due in large part to the commission, will also be due in great measure to Herbert Hoover, whose suggestions undoubtedly carried great weight with the President in making these appointments.

PERCY E. BARBOUR.

## Guaranteed Scales of Living

THE U. S. Coal Commission has issued an invitation to the public to suggest to it topics for discussion and to express itself freely. The Commission evidently intends to work a good deal in the open, which policy will meet with approbation. There is therefore no impropriety in discussing its work and the problems that are before it. Among the topics suggested by the Commission itself is the following:

> Standardizing a basis of arriving at the overhead cost of producing and distributing the coal, including delivery at the door of the consumer, recognizing in this compilation that the standardized cost of living to the miners should be the first and irreducible item of expense.

The limitation imposed by the Commission under this head is unfair and uneconomic. If a standardized cost of living to the miners is to be determined as the first and irreducible item of expense, why should not such a standard be determined for all other classes of people? If the national income be insufficient to afford an irreducible standard, how is it going to be provided? What more claim have coal miners for such a guarantee than all other classes of workers?

W. R. INGALLS.

## Handling the Industrial Problem

LEADERS of industry in general have been derelict in not cultivating the confidence of their employees, although there are some brilliant exceptions. Welfare work is obnoxious in name to the enlightened worker, and is accepted grudgingly and fails of its purpose too often because it is the wrong point of attack. You cannot force a man to increase his efficiency any more than you can legislate a man to be good. If a worker has confidence in his employer his efficiency will increase in spite of himself.

Square dealing alone will go a long way, but square dealing and frankness will win every worker who has brains enough to be a desirable employee. He cannot be expected to devise for himself the solution of the industrial problems pertinent to his job when they challenge the best intellect of the combined executives. Secrecy of costs is a fetish; sharing these figures with the intelligent employee makes him an interested partner more surely than intriguing him into purchasing the company's stock. His interest in his daily task is of more benefit to the employer than his transitory interest in his stock when the installments come due or the small dividend is received.

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One progressive president of a large metal industry has had a set of colored blocks made, one 3 by 3 by 21 in., painted red to represent a dollar of sales, and small 3-in. blocks of various colors in varying heights to represent the proportionate costs of raw material, labor, transportation, overhead, interest on investment, etc., etc., which go to make up this sales dollar. The distance from the top of this pile to the top of the long block is profit. This visualizes to the man as neither figures nor curves can do what his job means in the *tout ensemble* of the industrial problem. This president is making rapid strides in gaining the confidence of his men. The block novelty engages their interest and his frankness does the rest. This company will soon be, if it is not already, absolutely regardless of any distorted propaganda the labor unions may spread. The employees will be too well informed as to their interest to be misled.

When all employers make equally enlightened efforts to interest and educate their workers, the union presidents will be out of a job and the soap-box agitator will be without an audience.

When the Anthracite Coal Commission made its settlement with the unions, which preserved peace in that industry for 20 years, there were few figures available that threw any light on the income of the country. The president of one of the leading anthracite companies in the recent settlement pointed to Ingalls' book "The Wealth and Income of the American People" as a great achievement in this direction, but it came too late to help to keep them from being sandbagged by the union dictator. Why should not the leaders of industry put into the hands of its intelligent superintendents, foremen, etc., books of this nature which he who runs may read, so that they may become so well informed that they cannot be misled by the I. W. W. type of propagandist who is now becoming menacingly prominent. Another prominent operator has just written us regarding a recent editorial.

If the mine owners do not get together and present a solid front to combat unionism, the time is not far distant when the union will say how much the consumer must pay for his coal and how much must be paid to the union and the miners, if indeed that condition does not obtain already.

By this means, as by no other, the fallacy of the "living wage" fetish may be made clear to those to whom the slogan has such a strong sentimental and psychological appeal as well as to those who are directly involved who must stop obeying the labor union dictum of limited output and learn that to get more they must produce more.

The operators cannot successfully combat the blatant labor leader with his own weapons; besides, it is the wrong method anyway, but the labor agitator has no weapon to use against square, open and frank dealing which gain the workers' confidence and show him where his own best interests lie.

PERCY E. BARBOUR.

## America's Present Duty to Europe

SOME of our members have made the sun shine in the hearts and on the faces of millions of Russian people. The delegates attending the geological congress in Brussels were presented to King Albert, who came around to shake hands with each one of the group and to say something pleasant. Dr. David White, official delegate of the United States Government, presented to the King Mr. Hoover's regrets at not being present at this congress. The King smiled, straightened up and bowed, and said, "We consider Mr. Hoover our saviour."

In view of the work done there and in view of the work done by the American Relief Association, the A-R-A as it is called all over Russia and Europe, we should feel proud to be Americans, proud to be engineers. We should feel a thrill of exceptional pleasure that through our associates and members of our profession, citizens of our country have conducted with such conspicuous success, a work of unprecedented value to humanity.

That work, however, in a way, was purely humanitarian, was philanthropic. Have we nothing else to do? What I have just seen in Europe convinces me that the situation is perilous, and in some parts is certainly critical unless the United States, not solely from motives of philanthropy but from good sound business principles, does its part, and in no ungenerous way, in establishing a policy and in lending financial aid to the people of Europe who are now really struggling. They are unable to work themselves out of their present difficulties without a restoration of their credit. Unless we insist on helpful procedure on the part of our people, we are not living up to our principles, we are not performing our duty to the world.

The people of this country are not awake to the fact that we do not live alone, that the situation of the world concerns us sooner or later. We are in a moment of rather artificial exaltation; we believe that we are on the upward wave toward prosperity; we have been led by a sort of a propaganda to believe that everything is lovely. Do not think for a minute that this can be done by politics or by any political party. Do not deceive yourselves into thinking that everything is settled and good times are certainly here. Foreign markets will not furnish the demand for our products unless we help to furnish the wherewithal to buy our own products and furnish them to the people of Europe.

The bankers are considering a move in the right direction and are starting to educate our people, but the engineers also know something about the situation and have something to say; they should say it, and I am heartily in accord with the idea of spreading abroad the principle that America can no longer put a wall around itself and say that we are self-supporting and self-sufficient, so let the rest of the world go hang. Let us do our part.

HORACE V. WINCHELL.

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# Review of the Month

AT THE beginning of October, the outstanding feature in the world's affairs was the Turkish question. The Turks, victorious over the Greeks, repudiated the treaty of Sévres with the Allies and demanded their reestablishment at Constantinople and in Thrace. The British resisted, but deserted by the French and Italians, at a military conference at Mudania the Turks obtained about everything that they wanted. Great Britain suffered a loss of prestige that may bear evil fruit in the future. The possession of the Dardanelles by the Turks produced the ruin of Russia and Rumania in the great war, prolonged it two years and made it necessary for America to go in. Disruption of the entente puts the Turks back where they were. In America a strong and spontaneous reaction developed against this, not for any diplomatic reasons, but purely out of the sentiment that the atrocious Turks should be confined to Anatolia. Some strong leadership would have aligned the United States with Great Britain in this matter. As it is, the French have had their way but have alienated much of their American friendship.

The temporary composition of Turkish affairs at the Mudania conference had momentous consequences. The Greeks, having expelled King Constantine, in their distress and despair reverted to the guidance of Venizelos. Evacuation of the Grecian military forces and the entire Grecian population from Eastern Thrace began, the people not venturing to remain there. From all accounts their withdrawal, attended by great hardships, was reminiscent of folk movements in the Middle Ages. The vanguard of the Angora Government set foot in Constantinople, marking the return of the Turks to Europe, while the Allied forces remaining there temporarily stood in chagrin.

In Great Britain an important element of the Conservatives withdrew their support from the Coalition Government, thus leading to the resignation of Lloyd George, the installation of Andrew Bonar Law as premier and a general election with a tri-party contest among the Conservatives, Liberals and Labor, called for Nov. 15.

Civil war continued in Ireland, but attention was diverted from it by the more important events in the Near East.

The economic situation in Germany grew steadily worse, although amid other preoccupations it failed to attract the attention deserved. Toward the end of October it was admitted that the Stinnes-Lubersca agreement had been cancelled, through the inability of the Germans to live up even to it. This reopens the entire question of reparations. The German chancellor made the statement that he did not believe Germany would be able to continue what he called her policy of fulfillment. The long and short of it all is that the Germans have not been working hard enough and have been living beyond their means and have carried on up to this time largely by selling their currency to foreign speculators. They have now come to the end of their rope and the collapse that has been foreseen is imminent. It is to be anticipated that this will involve labor troubles, more socialistic experiments and general resentment against the inevitable among the people. Other countries, including the United States, will feel the repercussions of this.

In the United States attention was engaged by the approaching elections and there was a great deal of inanity talked and written. Among the people the predominant things appeared to be dissatisfaction with the general economic conditions and disgust for both the great political parties. By the time this magazine appears the result of the election will be known. During the campaign Hoover appeared as one of the chief spokesmen for the Administration and in a carefully prepared address on the subject of the foreign debts declared that the European debtors could pay what they owe and would be required to do so. This was accepted as a declaration of the views and policies of the Administration. It will be noted that they are at odds with the ideas about cancellation that are being expressed more and more by the bankers. Anyhow, October was signalized by Great Britain making her first interest payment.

The American Bankers Association met in New York during the first week of the month, and listened to many good addresses, in the main to the effect that the economics of Europe are very bad, that German reparations must be scaled down, that we must forgive Europe's governmental debts to us, and that in general we must play a great part in the rehabilitation of Europe. These recommendations were received very coldly by official Washington, but nevertheless the logic of events is causing a trend of thought in the bankers way. It was rather strange, however, that not even did the bankers see that the underlying evil in Europe's affairs is the desire of people to avoid hard work and practice self-denial and thrift, that the same thing exists in our own country, and that there are no leaders with the courage and common-sense to give them guidance.

Economically there was less gayety with respect to business prospects in the United States at the end of

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October than at the beginning. On sober second thoughts the idea of creating prosperity by advancing wages, no matter what the necessity, and by marking up prices, did not look so good, even to the enthusiastic, as it did at first sight. The apparent increase in activity looked more and more like the filling of voids occasioned by the strikes, and toward the end of October there were relaxations, evinced by the markets.

Among the metal markets iron and steel products became distinctly easier. Zinc experienced a reaction to about 6.60c., but upon publication of the September statistics, showing a further decline in stocks in first hands there was a swift rally to 7.05c. It is to be feared that this situation is being misread and that the decline in primary stocks may be ascribed to a transfer thereof to secondary. Lead continued strong at 6.50c., for excellent fundamental reasons. Copper showed some weakness, declining from 14c. to 13¾c. owing to a lull in buying and perhaps the feeling that the relatively cheap copper from South America is going to determine the market.

The Union Sulphur Co., Texas Gulf Sulphur Co. and the Freeport Sulphur Co., formed the Sulphur Export Corporation under the terms of the Webb Act, for the joint handling of the export business in brimstone.

By a decree dated Aug. 22, 1922, the Sicilian Sulphur Consortium was dissolved. The brimstone industry of Sicily is unable to compete with American production.

The Krassin-Urquhart agreement with respect to the Russo-Asiatic Company failed of ratification by the Moscow Government, which apparently thought that it could use this as a lever to cause Great Britain to recognize the Soviet Government. Mr. Urquhart has explained that for the moment politics has become mixed with business over this matter and that sooner or later ratification will be made.

The President announced the appointment of the commission to investigate the coal mining industry, discussed on this and previous pages.

Near the end of October a highly important event was the practical revolution in Italy whereby the Fascisti obtained control of the kingdom. This organized and uniformed party set out suddenly to obtain physical control of the country, effecting so widespread an uprising that martial law was declared by the government. Ex-premier Salandra having been requested to form a new government and having failed, the King directly ordered rescindment of the order for martial law, rather than to resort to military action as the only means of stopping the Fascisti. Benito Mussolini was thereupon requested by the King to form a new government, which was an unprecedented action inasmuch as the Fascisti have but relatively small representation in the Italian parliament. Let it be explained that the Italian Fascisti is a militant anti-socialistic movement whereof the object is the imposition of discipline upon the nation in order to increase economic expansion. It evinces a popular protest against the futile political administrations of the last four years. The political doctors in other countries are now in fear lest the victory of the Fascisti may tempt reactionaries to employ Italian methods and create anti-red organizations. Yet, what could be a better step toward national economic health in France and Germany and every country that has been tainted with socialism?

## Coal Commission Invites Help

AT CONFERENCES held the last week in October, between the U. S. Coal Commission and delegations representing mine-workers, bituminous, and anthracite operators, the letter which follows was addressed to each committee.

The U. S. Coal Commission appreciates the offer of coöperation on the part of your organization with it in the discharge of the duties imposed upon it by Act of Congress: "to investigate and ascertain fully the facts and conditions and study the problems and questions relative to the coal industry with a view to and for the purpose of aiding, assisting and advising Congress in matters of legislation which would insure a supply of this commodity to the industries and the people generally throughout the country and maintain the uninterrupted flow of commerce among the states, or any legislation which Congress may after said investigation deem wise and which under the Constitution Congress has the power to enact."

To this end the Commission very earnestly desires your advice and suggestions, in writing, as to the best means of ascertaining all the facts pertinent to the investigation it has been directed by law to make. The Commission particularly desires your carefully formulated views as to what efficient policy, if any, could, or should be adopted by the Government relative to the coal industry, having proper regard to the interests of the mine worker, the mine operator, and the public. Your intimate knowledge of the conditions which at present obtain in the coal mining industry, your recognition of the principle that there should be a "square deal" for all concerned, and your appreciation of the importance of arriving at the earliest possible date at some policy which would insure an uninterrupted and assured supply of coal at a reasonable price to the consumer, will enable you to render a great service to those engaged in the industry itself and to the nation as well by your cooperation with this Commission in carrying out the functions imposed upon it by the law.

In order to put the matter before you in a more concrete form for your consideration there is attached hereto a sheet giving the various topics upon which the law creating this commission requires it to develop facts or make recommendations.

The Commission desires you to go carefully over this list of topics and advise it in writing at your earliest convenience on the following points.

(*a*) What specific data should be secured under each one of the topics enumerated in the law in order to carry out adequately the direction of the law?

(*b*) What, in your judgment would be the best and most practicable method for the Commission to adopt for securing these data?

(*c*) What, if any, topics should the Commission investigate in addition to those already enumerated in the law, in order to give to Congress and the public complete information necessary to the proper understanding of the conditions in the coal industry?

(*d*) To what extent are you in position to cooperate with the Commission in securing necessary data in such manner as will eliminate in the largest possible degree any basis for criticism of the accuracy or the validity of the data which have been secured?

In addition to the above the Commission further desires you to advise it in writing at some date in the near future, tentatively:

(*e*) What, in your judgment, are the elements that have caused and are causing the acknowledged demoralization in the coal industry, and which are working hardship alike upon the parties engaged in the production of coal and the consuming public?

(*f*) What, in your judgment, are the practical remedies that would eliminate any or all of the elements that you feel are responsible for the condition?

JOHN HAYES HAMMOND, Chairman.

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# One Phase of the Problem of Increasing the Consumption of Copper

By H. H. STOUT

Consulting Metallurgist, Phelps-Dodge Corporation

THE high copper price during the war stimulated the capacity to produce far beyond a possible normal consumption. The curves in Fig. 1 show this. The line YZ indicates what the world production and consumption of primary copper normally would have been, had not the war upset the rhythm of industry.

Granting that the maximum world production of 3,150,000,000 lb. in 1917 was obtained by crowding both the equipment and the grade of ore mined, yet in many instances additional capital was invested, upon which the producer will be driven to earn at least a reasonable interest.

During the period of deflation, or liquidation, which we have entered, the consumption of copper will naturally be below the normal. Fig. 1 shows the actual consumption expressed in per cent. of normal: 1919, 96 per cent.; 1920, 94 per cent.; 1921, 70 per cent. The copper industry, consequently, faces: (1) Potential over-production capacity; (2) Diminished consumption. To deny the existence of these factors would be illogical. To minimize the menace of this potential producing capacity might lead to regret. All past attempts at artificial control have not proved very successful.

Obviously the remedy is to increase, if possible, the consumption of copper to a point where these factors cease to be dangerous. In ultimate analysis, this means: Produce an article so cheap and so good that no one can afford to use substitutes. The problem can be solved by: (1) Reducing price; (2) Improving product offered.

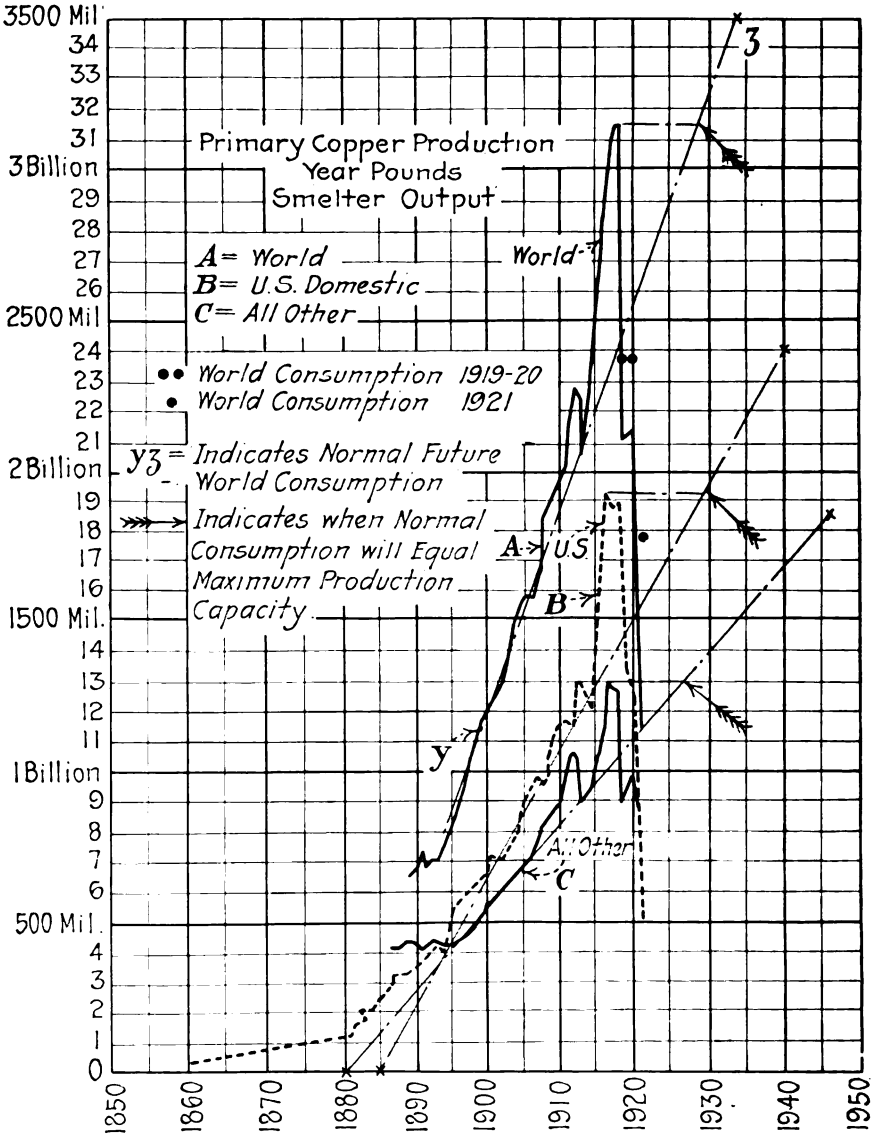


FIG. 1.

Fig. 2 illustrates average yearly price refined copper f.o.b. New York since 1850. It is seen that (exclusive of war conditions) the price of refined (not rolled) copper has steadily declined, notwithstanding that labor, fuel and all other elements which enter into production cost have steadily increased since 1850. This shows definite progess in the industry from the standpoint of production costs; in fact, were it not for this progress, the U. S. copper production would be a negligible quantity. Foremost in this line stands the development of the porphyries which have aided in

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raising the per cent. of copper produced in the United States to the point shown in Fig. 3.

It would appear that the copper producer has made very creditable progress in reducing the price of the refined copper product as sold by the refineries. This has been accomplished by definite advance in the art of mining, milling and smelting. Curiously enough, the plateau region west of the Mississippi seems to have contributed practically all of this progress. The rolling mill and fabricator are not included in this summary either positively or negatively.

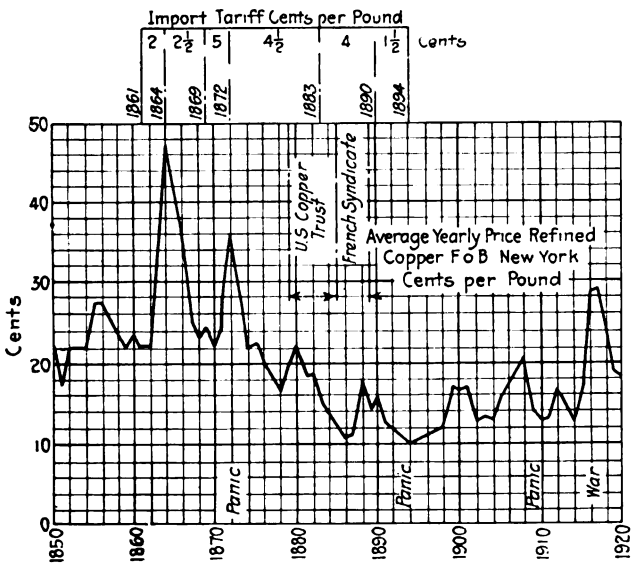


Fig. 2.

The next point of attack on the problem is improvement of the product, and the object of this article is to present one phase of copper metallurgy which may have some bearing on the subject. The particular step that will be discussed is the final one; namely, copper in the form of cathodes, or pure native copper, is melted in a reverberatory furnace and cast into the final marketable shapes and bars. This operation consists of:

A. Charging copper into the furnace (charging period).

B. Melting the copper by allowing a flame from coal or oil to play over the surface (melting period).

C. Blowing air through an iron pipe inserted beneath the surface of the molten metal for the purpose of saturating it with oxygen. The object of the oxygen saturation is to oxidize and remove impurities which have been absorbed from the furnace gases, primarily sulfur (oxidizing period).

This is called, also, flapping period, because the oxidation is sometimes done by flapping the surface with a rabble.

D. Reducing the molten metal by inserting poles. This removes the oxygen previously put into it (poling period).

E. Running the molten copper out into molds. During this time (about 4 hr.) the surface is kept covered by charcoal and short pieces of wood (casting period).

To summarize: A. Charging; B. Melting; C. Flapping; D. Poling; E. Casting.

To begin with, it may be stated that the methods used in these five steps are identical with those followed as far back as there is any history of the art. In other words, there has been no progress in this particular operation in many centuries, which means either that the ancients were very brilliant, or that we moderns are very stupid. This fact alone should give food for thought.

At the completion of the oxidizing period, the molten metal should contain at least 0.38 per cent. oxygen, which is 3.46 per cent. copper oxide. In this small amount of copper oxide, all the remaining copper

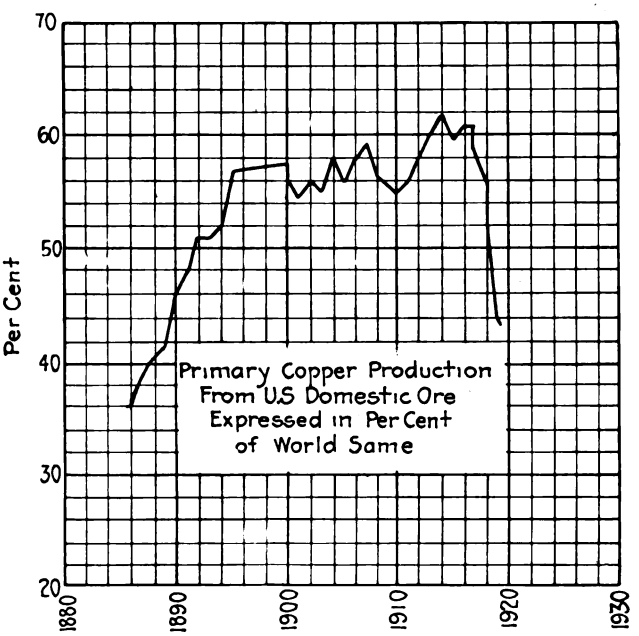


Fig. 3.

crystals are soluble, so the metal is 100 per cent. copper-copper-oxide eutectic and does not contain any undissolved copper crystals.

Stated in another way, its purity is zero for the reason that the eutectic is a substance that is practically worthless, as far as physical qualities are concerned. More particularly, it is readily attacked by many of the gases found in normal atmosphere, and to the presence of this substance in sheet copper can be traced nearly all of the few failures of the metal which have caused engineers and architects to be averse to its more extended use.

After the molten metal reaches 100 per cent. eutectic, all impurities have been removed by the oxygen. Since 0.4 per cent. oxygen means 100 per cent. impure eutectic, it follows that 0.1 per cent. oxygen remaining in the finished product means 25 per cent. impurity. Stated in a more concrete way: The impurity present is 250 times the oxygen content.

Standard specifications for refined copper are:

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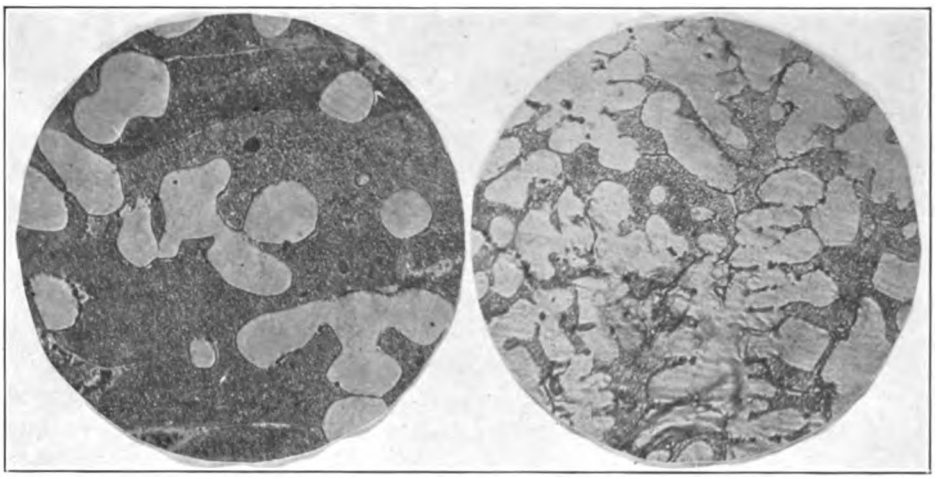
Cu = 99.681
O = 0.311

Eutectic = 81.6%
Purity = 18.4

100.0



Cu = 99.810
O = 0.183

Eutectic = 47.1%
Purity = 52.9

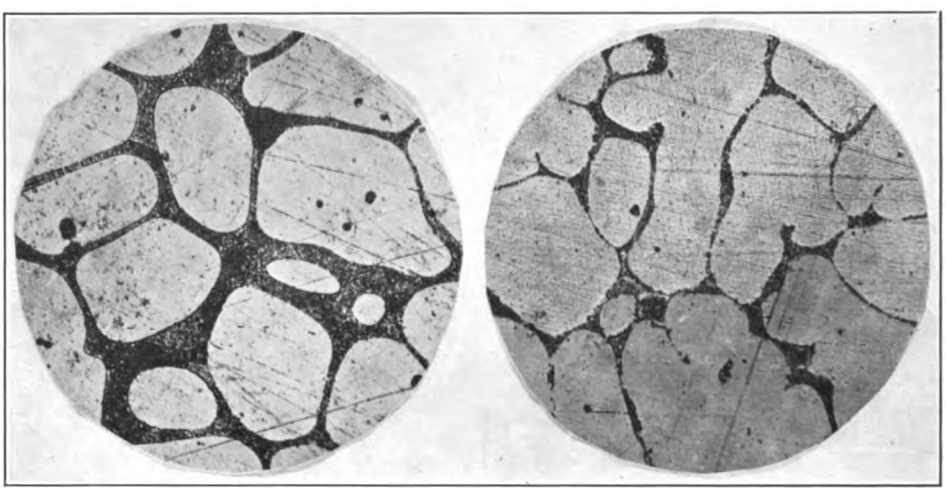
100.0

FIG. 4. FIG. 5.

Cu = 99.901
O = 0.092

Eutectic = 24.2%
Purity = 75.8

100.0



Cu = 99.945
O = 0.046

Eutectic = 12.1%
Purity = 87.9

100.0

FIG. 6. FIG. 7.

Cu = 99.987
O = 0.008

Eutectic = 2.0%
Purity = 98.0

100.0

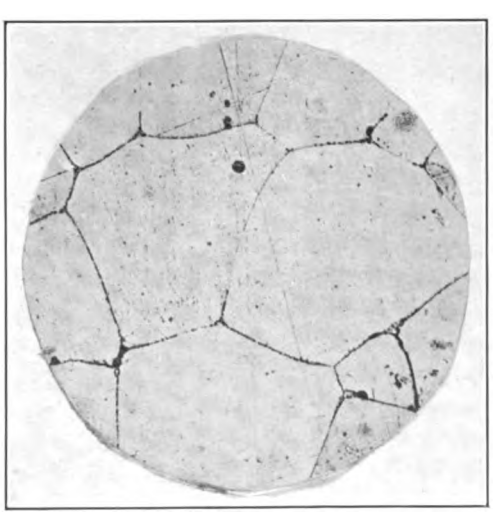


FIG. 8.

FIGS. 4-8.—100×. ETCHED. STRUCTURE OF COPPER CONTAINING VARIOUS AMOUNTS OF OXYGEN. THE DARK MATRIX (EUTECTIC) IS THE BINDER FOR THE LIGHT COPPER CRYSTALS. THE ORTHODOX METHOD OF STATING THE COPPER CONTENT DOES NOT GIVE A TRUE PICTURE OF THE PURITY OF PRODUCT.

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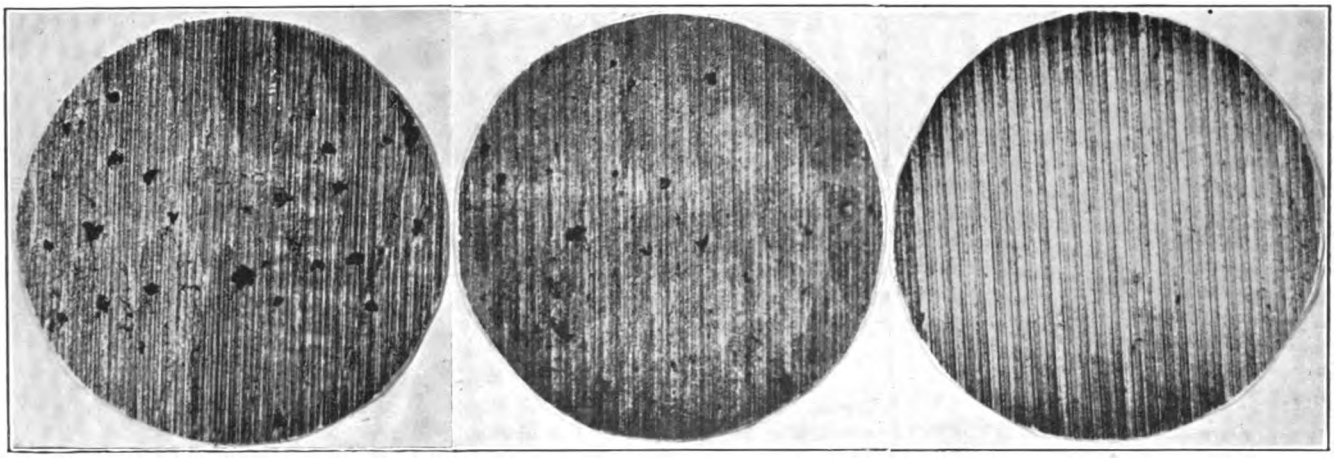


FIG. 9.—½ IN. BELOW TOP SURFACE.

FIG. 10.—CENTER OF BAR.

FIG. 11.—½ IN. ABOVE BOTTOM SURFACE.

FIGS. 9–11.—10×. AT THREE POINTS IN SECTION OF NORMAL WIRE BAR. Cu = 99.962. THE STRIATIONS ARE TOOL MARKS WHERE SECTION WAS CUT. THE DARK SPOTS GIVE TYPICAL SIZE AND LOCATION OF GAS BLOW HOLES IN ALL CAST PRODUCTS. THIS GAS HAS FAILED IN ITS ATTEMPT TO ESCAPE BEFORE THE FINAL SET.

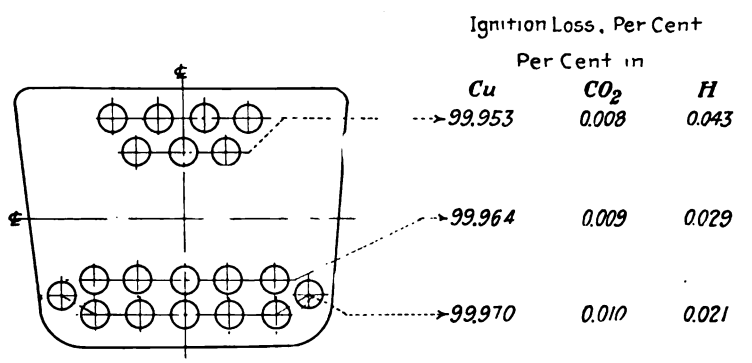



FIG. 12.—COMPLETE SECTION. NORMAL WIRE BAR (HALF SIZE) SHOWING SEGREGATION OF EUTECTIC. PRESUMABLY THE GAS BUBBLES, WHICH RISE TO SURFACE IN THEIR ATTEMPT TO ESCAPE DURING COOLING AND SETTING, CARRY EUTECTIC UPWARD.

Cu = 99.987
O = 0.0007
S = 0.0002
H = 0.01–?
99.9979

FIG. 13.—REDEPOSITED ELECTROLYTIC CATHODE COPPER.

Cu = 99.987
O = 0.008
S = 0.0001
H = 0.003–?
99.9981

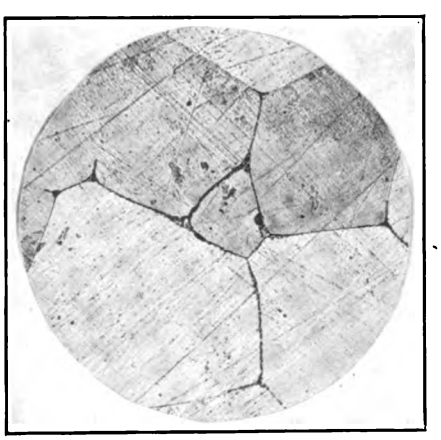
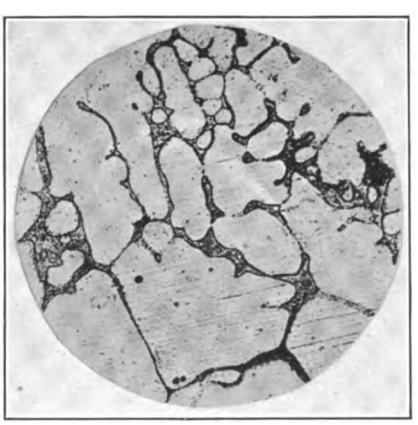


FIG. 14.—PREPARED HIGH COPPER CAST SAMPLE MADE FROM NO. 13 BY MELTING IN $CO_2$.



Cu = 99.906
O = 0.09
S = 0.001
H = 0.0
99.997

FIG. 15.—PREPARED COMMERCIAL STANDARD COPPER CAST SAMPLE MADE FROM A STANDARD WIRE BAR BY REMELTING AND OXIDIZING.

FIGS. 13, 14 and 15.—100×. ETCHED. COPPER USED IN THE TESTS.

NOTE.—To emphasize effect of certain gases during annealing a copper as high in oxygen as possible and yet within standard specification (0.1 per cent.) was desired.

No copper of this oxygen content could be obtained on the market, therefore it was prepared from a piece of standard commercial wire bar which originally contained 0.046 per cent. oxygen. See Fig. 15.

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Copper, not less than 99.88 per cent.
Oxygen, not more than 0.1 per cent.

Figs. 4 to 8 show that refined copper within these specifications is in reality 73.6 per cent. purity.

Another source of physical defects are certain gases which are soluble in the molten metal. As the metal is cooling in the molds, hundreds of minute specks of copper being projected upward from the molten surface can be seen. This is the gas which (not being so soluble in the cold metal) is being expelled during cooling. Figs. 9 to 12 illustrate the fact that some of this gas fails to escape. It may be added that many individual bars from many refineries were examined, and not one was found free from these gas pockets.

The sheet copper used in the trades and arts is made from the bars produced by the refinery by rolling, annealing, rolling again, then annealing, etc., until the desired thickness and size is secured. The annealing consists in heating the copper to about 1500° F. and maintaining it at that temperature for various lengths of time (depending on its character). The heat is applied by allowing the flame from commercial fuel, coal, oil or wood to pass around the metal as it is piled in the furnace. The combustion gases from commercial fuel playing around this metal contain in various amounts: oxygen, nitrogen, hydrogen, hydrocarbons, sulfur, CO, $CO_2$ $SO_2$, etc. The relative amounts of each gas change from time to time and it is absolutely impossible to so regulate the combustion that a definite desired composition is always maintained.

Figs. 16 to 27 indicate the effect of some of the annealing furnace gases *per se* upon commercial standard copper and upon high-grade copper. Figs. 13 to 15 show the samples used with their method of preparation. A perfectly fair and logical conclusion may be drawn to the effect that notwithstanding all the care and regulation with which the annealing furnaces are operated, it is possible to change the chemical and physical properties of the sheet copper product.

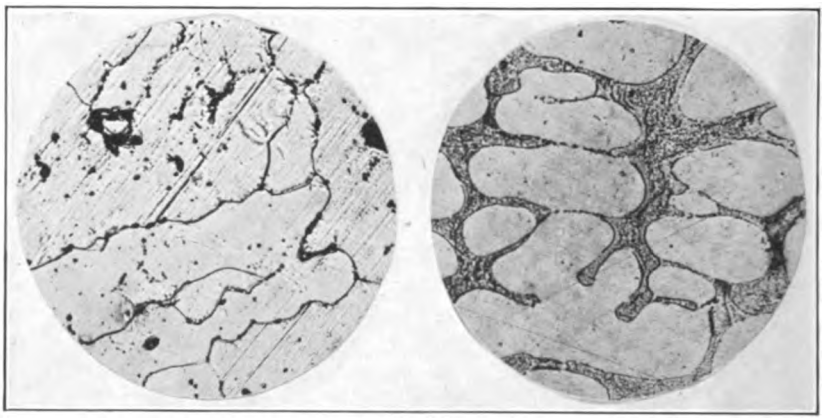
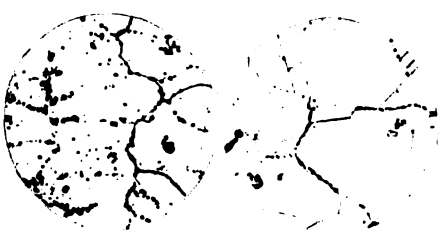


FIG. 16.—$H_2$
Cu = 99.966
O = tr
S = tr
H = 0.03–?
Porous—Brittle.

FIG. 17.—WATER GAS.
Cu = 99.940
O = tr
S = tr
C = 0.048
H = 0.01–?
Carbon replaced O all through metal.
Porous—Brittle.



AT CENTER NEAR SURFACE

FIG. 18.—CO.
Cu = 99.929
O = 0.065
S = 0.001
H = 0.0
Brittle. Spotty. Recrystallized.

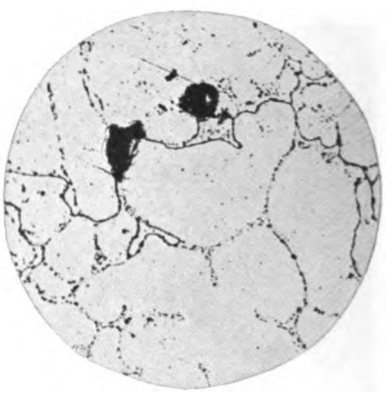


FIG. 19.—$CO_2$.
Cu = 99.904
O = 0.092
S = 0.001
H = 0.0.
Not affected.

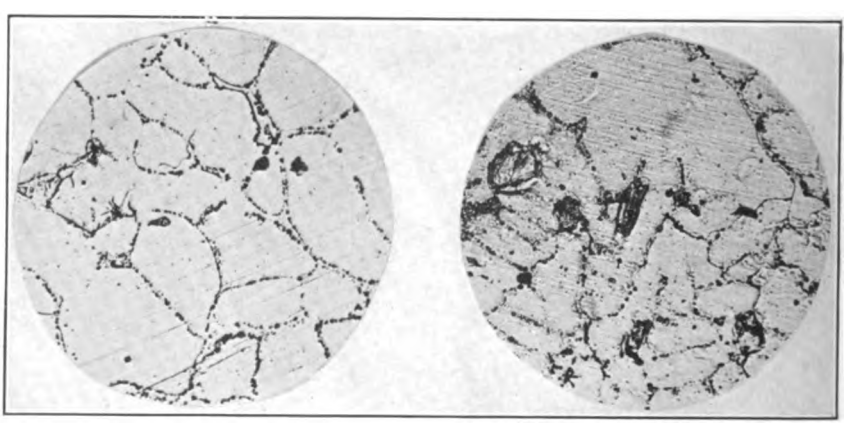


FIG. 20.—AIR.
Cu = 99.898
O = 0.095
S = 0.001
Slight increase
0–?

FIG. 21.—$SO_2$.
Cu = 99.903
O = 0.092
S = 0.0008
Not affected.

FIGS. 16–21.—100×. ETCHED $H_2O_2$ + $(NH_4)OH$. PREPARED COMMERCIAL STANDARD COPPER CAST SAMPLE NO. 15, ¼ IN. THICK, ANNEALED 3 HR. IN CURRENT DRY PURIFIED GASES AT 1500° F. BEFORE ANNEALING Cu = 99.906, O = 0.09, S = 0.001. ANALYSIS AFTER TEST SHOWN WITH EACH FIGURE.

NOTE.—Deoxidation No. 18 was progressive from surface to center. The surface was completely deoxidized while the center was not affected in 3 hr. Rearrangement crystals from anneal shown in Fig. 18.

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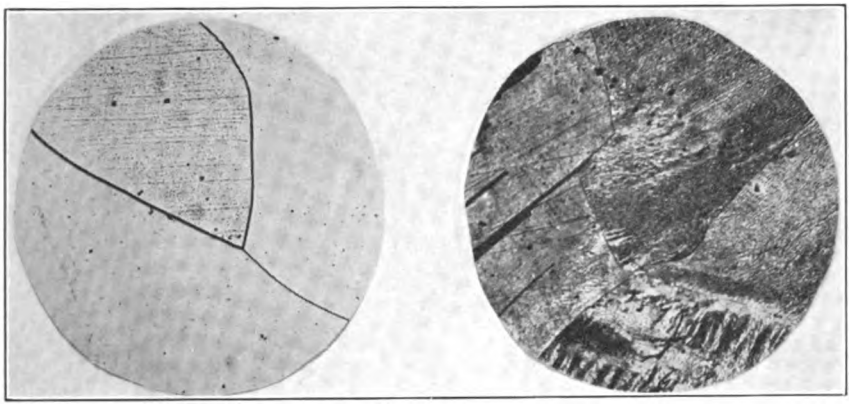

FIG. 22.—$H_2$.
Cu = 99.990
O = tr
S = tr
H = 0.006–?
Tough.

FIG. 23.—WATER GAS.
Cu = 99.989
O = tr
S = tr
H = 0.006–?
Tough. Recrystallized.

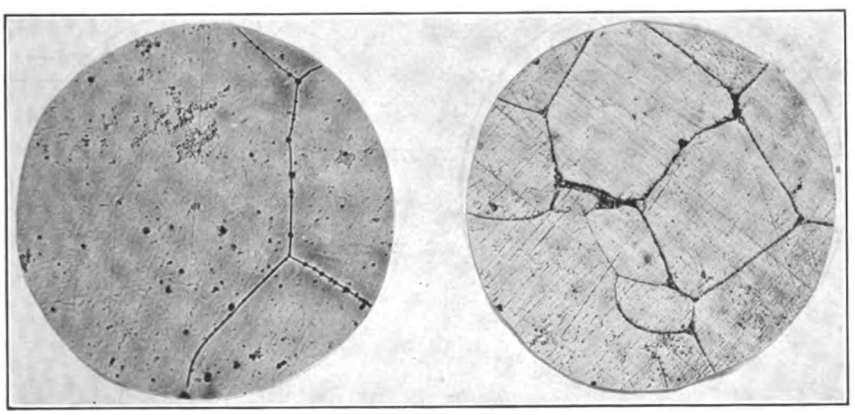

FIG. 24.—CO.
Cu = 99.988
O = 0.006
S = 0.0001
H = 0.003–?
Progressive deoxidation from surface toward center of piece.
Tough.

FIG. 25.—$CO_2$.
Cu = 99.987
O = 0.008
S = 0.001
H = 0.003–?
Not affected.

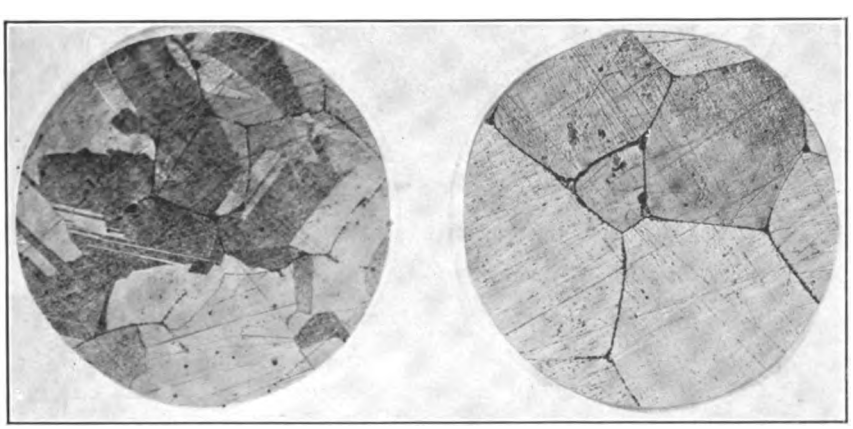

FIG. 26.—Air.
Cu = 99.987
O = 0.008
S = 0.0001
H = 0.003–?
Not affected except partial recrystallization.

FIG. 27.—$SO_2$.
Cu = 99.987
O = 0.008
S = 0.0001
H = 0.003–?
Not affected.

FIGS. 22–27.—100×. ETCHED $H_2O_2$ + $(NH_4)OH$. PREPARED HIGH COPPER CAST SAMPLE NO. 14, ¼ IN. THICK, ANNEALED 3 HR. IN A CURRENT OF DRY PURIFIED GAS AT 1500° F. BEFORE ANNEALING Cu = 99.987, O = 0.008, S = 0.0001, H = 0.003 – ? ANALYSIS AFTER TEST SHOWN AT EACH FIGURE.

NOTE.—No carbon detected beneath surface in No. 23. Rearrangement crystalline structure from long annealing seen in Nos. 23–26. Physically all sample tough.

Also, the lower the per cent. of eutectic (or per cent. of oxygen) the less is this likely to happen.

Why can't all oxygen be removed in poling? During the casting period, the flame from commercial fuel containing hydrogen and $SO_2$ plays over the surface of the molten bath, and for about 4 hr. it absorbs these gases in a greater or lesser degree. In order to offset the evil effects of these two gases on the final bar, the furnaceman is forced to allow some oxygen to remain, as that is the only way he can produce a casting that will "get by." This was explained and illustrated regarding sulfur by Skowronski.[1] The theory of absorption of reducing gases in general was propounded by Frederick Johnson.[2]

Figs. 28 to 33 seem to clear up some points heretofore suspected. From these might be drawn the following tentative conclusions, which may or may not be altered by future research:

*Hydrogen.*—It is absorbed by molten copper and when the hydrogen has reduced all the oxygen it is highly soluble, producing a hollow core in final casting.

It is absorbed by the solid metal hot and cold and penetrates the entire mass.

*Hydrocarbons.*—No conclusion can be drawn as to their solubility in molten copper (from the hollow casting) as the commercial illuminating gas used contained hydrogen also.

Some hydrocarbon compounds are absorbed by the solid hot metal, penetrating the entire mass, reducing the oxygen and leaving carbon distributed throughout the interior of the metal.

*Sulfur Dioxide.*—It has no appreciable effect on solid copper, hot or cold.

If the oxygen content of molten copper falls below a certain mass reaction balance, $SO_2$ is disassociated, absorbed and both O and S combine. The S forms a copper-copper-sulfide eutectic. The copper oxide separates out as individual crystals.

[1] A. I. M. E. *Trans.* (1919) **60**, 307.

[2] *Jnl.* Inst. Met. (1910) **4**, 163; *Jnl.* Soc. Chem. Ind. (July, 1917).

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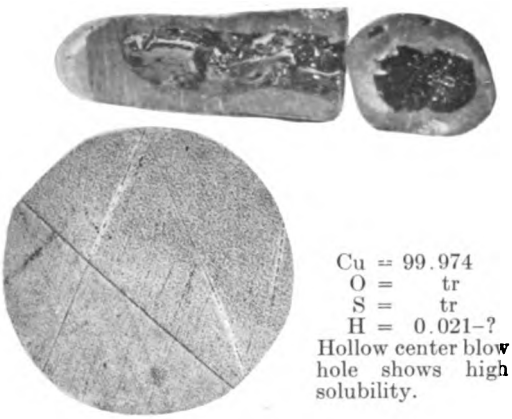
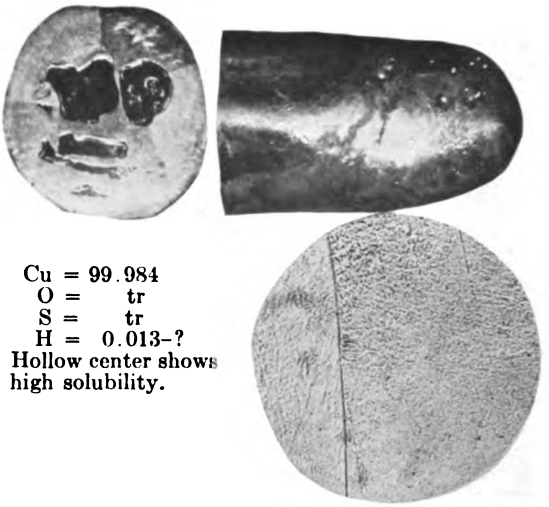


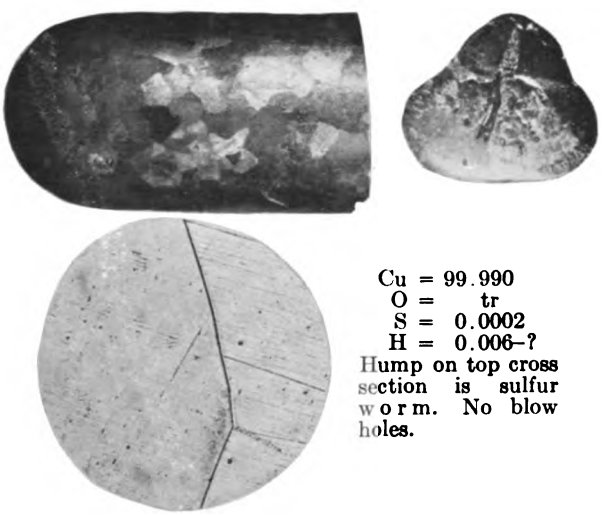
Cu = 99.974
O = tr
S = tr
H = 0.021–?
Hollow center blow hole shows high solubility.

FIG. 28.—$H_2$.



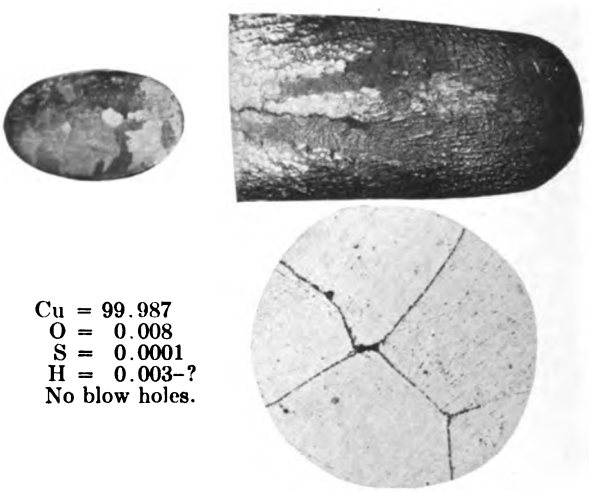
Cu = 99.984
O = tr
S = tr
H = 0.013–?
Hollow center shows high solubility.

FIG. 29.—WATER GAS.



Cu = 99.990
O = tr
S = 0.0002
H = 0.006–?
Hump on top cross section is sulfur worm. No blow holes.

FIG. 30.—CO.



Cu = 99.987
O = 0.008
S = 0.0001
H = 0.003–?
No blow holes.

FIG. 31.—$CO_2$.

FIG. 32.—$SO_2$

Cu = 99.899
O = 0.049
S = 0.050

←NOTES A. Matrix is now a copper-copper-sulfide eutectic and not an oxide eutectic.
B. Copper oxide present appears as individual black crystals.
C. $SO_2$ evidently decomposed and both resulting S and O absorbed and combined.
D. The copper-copper-sulfide matrix seems to lack strength as the casting resembles granulated lump sugar which is easily disintegrated by point of knife blade.

FIGS. 28–32.—REDEPOSITED ELECTROLYTIC CATHODE MELTED AND COOLED AT ATMOSPHERIC PRESSURE IN A CURRENT OF DRY PURIFIED GASES (TR. OXYGEN IN $CO_2$). MICROGRAPHS 100×, ETCHED, SHOW CRYSTALLINE STRUCTURE. PICTURES (FROM 1½ TO 4-×) SHOW RELATIVE SOLUBILITY OF EACH GAS BY SIZE OF BLOW HOLES IN CASTING. CATHODE BEFORE MELTING: C = 99.987, O = 0.0007, S = 0.0002, H = 0.01 – ? ANALYSIS RESULTS OPPOSITE EACH FIGURE.

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*Air.*—It oxidizes from the surface all copper in whatever state.

*Carbon Dioxide.*—It is neutral to all solid copper, hot or cold.

It is neutral to pure molten copper.

*Carbon Monoxide.*—It reduces copper-copper-oxide eutectic in solid copper progressively from the surface.

If at all, it is only slightly soluble in molten copper. The small holes in the CO melt micro are similar to the hydrogen melt micro, and hydrogen was present in the cathode used in the CO melt.

From a practical standpoint, these mean that after copper is melted it must be removed from contact with the combustion gases resulting from commercial fuel and which contain hydrogen and $SO_2$. It can then be oxidized by air and reduced by charcoal, and practically a perfect product will result (See Fig. 33). This points to an electric furnace. Since all cathodes contain some sulfur from the copper sulfate occluded between its crystals, the copper after melting must be flapped to remove this sulfur. It follows that nothing would be gained by melting cathodes in an electric furnace. They can be melted in a tall cupola requiring no waste heat boiler and operating 24 hr.; inexpensive to build and cheap to operate. The melted copper can be oxidized in the cupola bath, or after it is transferred to the electric furnace. It can be reduced after transfer to the electric furnace by addition of charcoal (no hydrogen) and then cast in stationary molds.

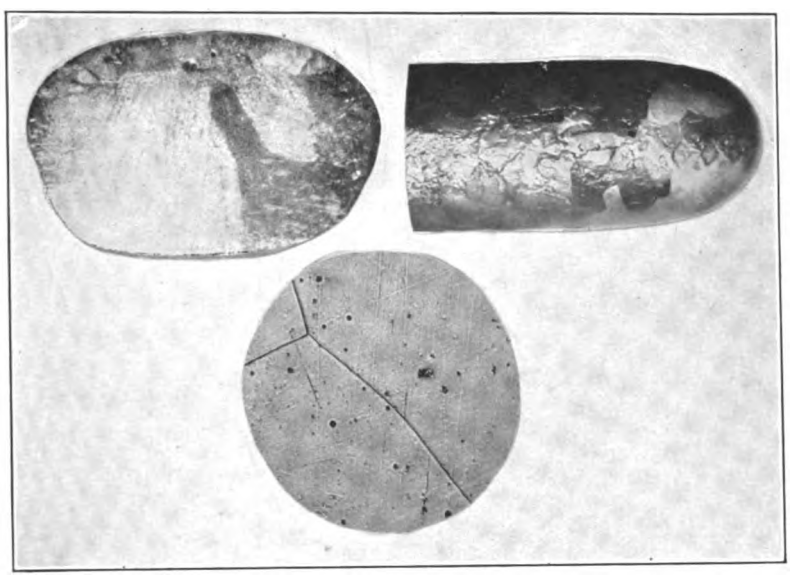

FIG. 33.—DESULFURIZED CATHODE MELTED IN CO.

Cu = 99.990,
O = tr,
S = tr,
H = 0.006–?

NOTE A. No sulfur worm.
B. Small gas holes in micrograph and three in picture section. These are either CO or hydrogen. From similarity to cathode analysis, it is assumed as hydrogen absorbed during annealing of cathode and can only be expelled by the usual flapping.

The gases in contact with the molten metal will be CO until all oxygen is removed and then $CO_2$. If all the sulfur found in commercial charcoal were absorbed by the copper, it would amount to 0.000001 per cent. in the finished casting, which would not affect the product.

The sulfur worm resulting from 0.0002 per cent. S in No. 30 caused an attempt to remove all S from cathode. By oxidation to 0.4 per cent. (flapping), all sulfur was removed, but when attempted in the alundum boat it slagged. The slag did not separate from the copper and this method was abandoned. Redeposited electrolytic cathode was then annealed at 1500° F. for 2 hr. in hydrogen and then annealed at 1500° F. for 2 hr. in $CO_2$. Only traces of O and S were obtainable, but some absorbed gas, presumably hydrogen, was present. After double annealing but before melting: Cu = 99.990, O = tr, S = tr, H = 0.006–? This was then melted and cooled at atmospheric pressure in a current of dry purified CO.

Some of the brass industry have recently adapted the electric furnace to their work. They melt the brass by electricity, which is expensive; and notwithstanding this we are given to understand that not only are their operating costs lower (when losses are considered) and that the highly skilled and mysterious melter is a thing of the past, but best of all, they can control the character of their product. They, too, had previously made no progress for centuries. From them we find that maintaining copper in a molten condition by electricity (after it is melted) is a relatively small cost.

Recently there has been developed a bauxite lining fused under an electric arc which, when used in these same brass induction furnaces, proved satisfactory in resisting the erosion of copper melted in them. The successful work by this new lining seems to pave the way for the adaptation of the electric furnace to the copper industry.

It has long been known that there are certain alloys of copper which possess very excellent physical characteristics, but to produce them in a furnace fired by commercial fuel was not feasible. The electric furnace removes all obstacles to this development. The steel industry produces in this way many alloys, each suited to its particular function. Judging from the prices we are all very willing to pay for the superior qualities of these steel alloys, this branch of the industry has not decreased its earnings.

Passing from metallurgy to policy, it might be interesting to speculate on why it is that practically all progress in the copper-producing art has originated in the West; but, as Kipling says, "That is another story."

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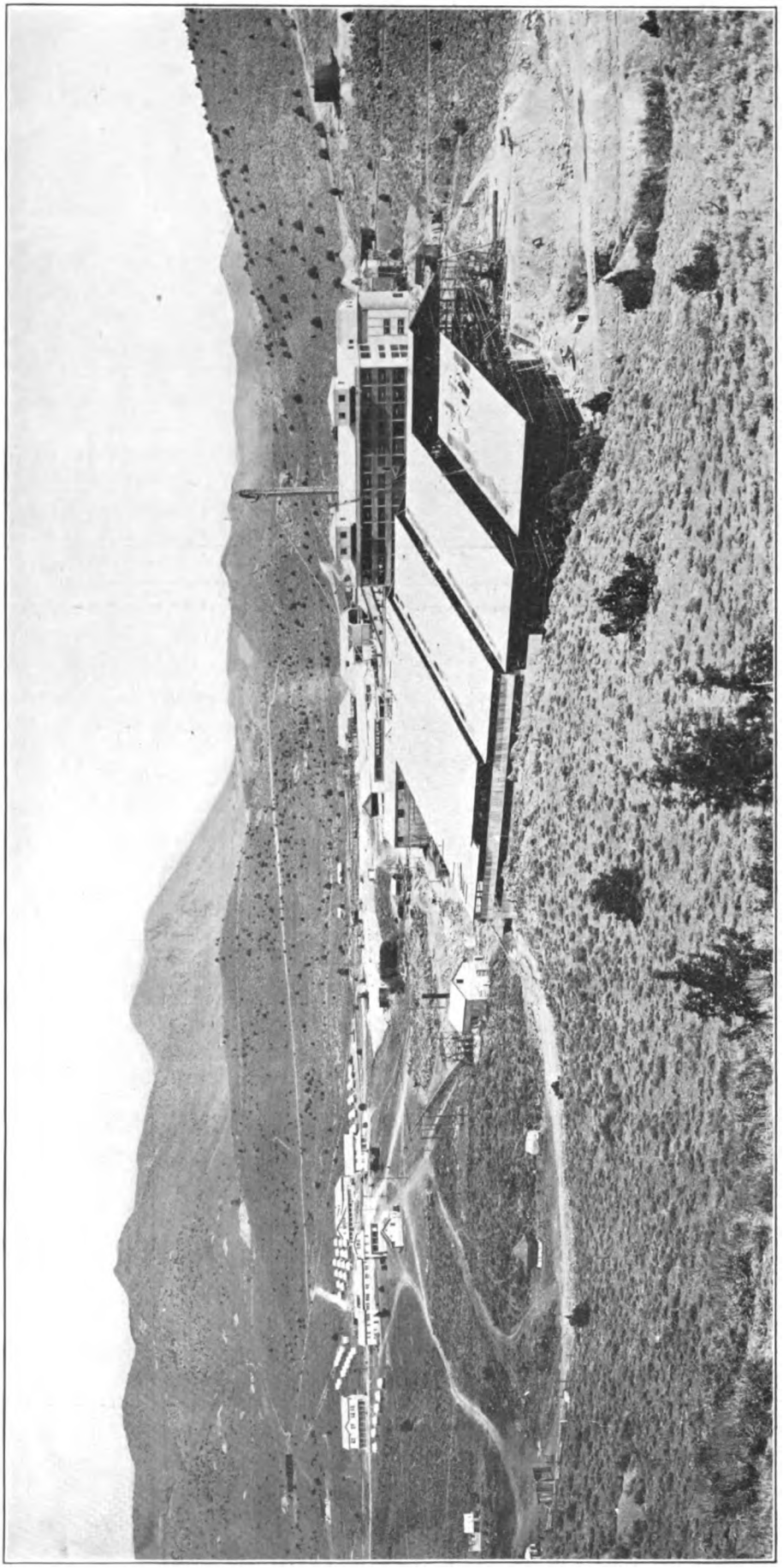

THE NEW COMSTOCK AND THE MILL OF THE UNITED COMSTOCK MINES CO.
On the far sky line at the foot of the mountain slope in the center lies Virginia City and the old Comstock lode now being tapped by a tunnel from the mill site, the entrance to which is seen at the end of the trestle above the mill.

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# One Hundred and Twenty-sixth Meeting of the A. I. M. E.

By HERBERT R. HANLEY

Mining and Metallurgical Engineer, Bakersfield, Cal.

THE One Hundred and Twenty-sixth meeting of the Institute, held in San Francisco, Sept. 25 to 29, 1922, was a success in every way. Characteristically, San Francisco presented climate suited to the occasion, while the Committees on Arrangements left nothing undone that would contribute to the interest and entertainment of the members and their wives. There was a registration of over 230, and all sections, save three, were represented.

In the technical meetings, under the leadership of Albert Burch in the mining session and C. W. Merrill in the milling session, the greatest interest was manifested in ore-hunting geology and modern ore-dressing methods. The general geologic phase developed numerous discussions and had for its aim the study and correlation of known data and the application of these to the finding of commercial orebodies.

The geologic features of the Comstock and their significance to the development of the present orebodies were discussed. This brought out matters of much technical interest as well as those of romantic nature in the history of the early life of that camp. The profitable application of modern milling methods to ores, non-commercial a short time ago, was discussed with much interest. The recent work on the Comstock ores occupied a conspicuous part in these discussions. Basic principles delineated by mathematical study of mechanical devices for the milling of ore came in for a prominent part in the program as well as the physical-chemical side of the processes devised for the winning of precious metals as a profit.

### Sessions Opened by Albert Burch

Chairman Burch opened the Monday mining session with a cordial welcome to the men of the profession, and an expression of pleasure that the Institute meeting was being held in the city of San Francisco. He then introduced President Arthur S. Dwight, who spoke on the general policies of the Institute. Secretary Sharpless, who followed, spoke of the cordial reception that had been accorded the Eastern party and the spirit of good fellowship that lives in and long survives these occasions. Mr. Sharpless appreciates the necessity for the getting together of engineers. He thinks that the broadening influence of such association will break the shell into which they are too likely to crawl, and he believes that the public should know something of their work and its importance to industrial, economic and political life.

The visit to the property of the United Comstock Mines Co. was part of the itinerary of the engineers and their families. Everyone was impressed with the magnitude of the work of the rehabilitation of this historic camp. Bulkeley Wells has been the outstanding factor in this enterprise; his work there and elsewhere in Nevada is a substantial tribute to his foresight and ability.

### Mining Geology Session

The paper presenting the economic geology of the United Comstock mines, by Wilbur H. Grant, was read at the Monday morning mining session. This property covers the south end of the lode in which there is a length of 3000 ft. known to have been productive. This has not yet been opened for work. The commercial ore will be mined from the old fills, also from the walls. The paper records the tonnage and net values of the ore mined from the area now owned by the United Comstock Mines Co. prior to and subsequent to 1880. In round figures, these are 3,000,000 tons of ore and $100,000,000 in precious metals, 93 per cent. of which was produced prior to 1880.

The next paper was a description of the Aztec mine, prepared by Charles A. Chase and Douglas Muir. This paper discourses on a relatively small ore deposit of unusually high grade. The dissertation on the geology and mineralization of these deposits is highly technical. The orebodies noted are: a contact shale ore high in gold, a mineralization with calcite and pyrite as persistent minerals, accompanying minor faults and an orebody that occurs almost exclusively in sandstone and has chalcopyrite as its characteristic mineral.

Three other papers of geologic interest were read by title only: "The British Columbia Batholith and Related Ore Deposits," and "Deposition of Copper Carbonate from Mine Water," both by Philip D. Wilson of Warren, Ariz., and "The Ore Deposits of Sierra Mojada, Coah., Mexico," by S. F. Shaw, Esmeralda, Mexico.

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The first paper presented at the session on Monday afternoon was prepared by John R. Reigart, superintendent of mines of the United Comstock Mines Co. It outlines the underground system of handling ore and method of stoping.

The next paper, "Metal-mine Ventilation in the Southwest," by Chas. A. Mitke, Bisbee, Ariz., presented a highly specialized work. The maintenance of an atmosphere underground best suited to the health of the men was the aim of this work. This involved a detailed study of dust, its origin, degree of comminution and control, as well as air temperature, humidity, degree of heat stagnation, motion of air, radiation of heat from the human body and convection currents.

"Shot-firing by Electricity," by N. S. Greensfelder, Wilmington, Del., gave an outline of the history of electric shot firing and led up to the improvements in the delay-action exploders; it also discussed parallel and series connections and the machines used in the work.

This was followed by a paper on "Mining Methods in the Mineville (N. Y.) District," by Earl C. Henry, which was read by the Secretary. This presented operating characteristics in mining a crystalline magnetite orebody and the method of estimating tonnage by diamond drilling. Safety and welfare work is a part of the program.

The last two papers in this session were read by title. These papers, "Sampling and Estimating Orebodies in the Warren District," by R. N. Dickson, Bisbee, Ariz., and "Methods of Sampling and Estimating Ore in Underground and Steam-shovel Mines of the Copper Queen Branch of the Phelps Dodge Corporation," by R. W. Prouty and R. T. Green, are of much technical interest and are the result of practical field work.

## Milling Session

The milling session was opened at 2 p.m. Monday, in a parlor of the Palace Hotel, by Chairman C. W. Merrill. The first two papers on milling methods and metallurgy of the United Comstock Mines Co., by Walter L. Reid and A. J. Weinig, were read by Mr. Merrill. These deal with the nature of the ore, the influence of the soluble salts present and the treatment. The ore is ground to four mesh and the soluble salts are washed out by a water treatment. The salt-free ore is then treated by the cyanide process. The relative effectiveness of the water wash prior to cyanide treatment will be seen by observing the figures for cyanide consumption. These figures show that without the water treatment the cyanide consumption is six times as great as with it, and the lime consumption three and one-half times under like conditions. A primary and a secondary slime are produced and are treated separately. These slimes occasion a high consumption of cyanide. The water discharge sand is sent direct to regrinding units, where it comes in contact with cyanide solution. Chas. Butters, in discussion, reviewed some of his early work in this camp, bringing out the toxic effect of organic matter. Mr. Merrill said that in most cases these ill effects can be removed by subjecting this organic matter to oxidation.

The paper by Ernest A. Hersam, "Factors Controlling the Capacity of Rock Crushers," was read by title. The factors referred to in this article are shattering, resistance, speed, slipping interference, density of rock, coarseness of feed, mixture of fines and coarse and vertical distance the rock must fall or slip to arrive in the zone of crushing.

## Concentration and Flotation

Prof. Theodore Simons reviewed his paper on the mathematical study of basic principles of gravity concentration. In this work the author brings a message to the profession, indicating the importance of the study of basic principles in any work undertaken. He indicated that new things might be predicted by pure mathematical equations. His work was started before flotation received such wide application. Mr. Butters, in discussing the ideas conveyed by this paper, thought it would be well to study concentration over again. Re-education on some partly discarded subjects was thought desirable, especially now that our processes are more flexible and interlocking, and there are greater demands in the matter of treating extremely low-grade ores, which were non-commercial a few years ago.

The next paper was a research on phenomena in flotation in which surface tension and adsorption play the principal parts, by A. F. Taggart and A. M. Gaudin. This was read by title. The dissertation discourses on apparatus and procedure, frothing, solution and emulsion phenomena, adsorption at air liquid and solid surfaces, orientation of molecules in the surface film, and the relation of surface tension to flotation.

The paper by John Gross and J. Walter Scott, "The Mechanism of Gold and Silver Precipitation on Charcoal from Cyanide Solution," was read by Mr. Gross. This occasioned numerous discussions extending well into the afternoon. This article dips into the theory and practice of gold and silver cyanide precipitation on charcoal and presents the study of the possible three ways in which the precipitation has been presumed to occur; *i.e.*, (1) as metallic gold and silver; (2) as a different chemical compound; (3) as an adsorbed salt.

The authors' conclusions are that metallic deposition or a change in chemical composition are not supported by evidence, but that adsorption does explain the manner in which the precipitation takes place. The precipitation occurs throughout the charcoal, and the gold is present as a sodium aurocyanide. Mr. Gross stated that the charcoal became fully loaded when 2000 oz. of precious metals per ton were present. The gold and silver cannot be dissolved out of the charcoal effectively, and burning is necessary to recover them. Inquiries were made as to other

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methods of extracting the metals from the charcoal, among which was the suggestion of chemically active gases. Specifically, the use of chlorine was suggested to change the precious metals into chlorides from which they might be volatilized or dissolved by commercial reagents. The speakers realized that at present the commercial features are not apparent in the work, but it was another instance of the search for fundamental principles, and this may lead to matters of commercial importance.

### Discussion of Various Papers

Tuesday evening was set aside for a dinner, followed by a period for discussions of papers which had been presented at some previous meetings when there was insufficient time for comment. There was a good attendance for dinner and all stayed for the discussion. Chairman Burch opened the meeting, and the conference was started by the reading of a poem by E. P. Mathewson ! !

Most of the evening was devoted to discussions on prospecting and ore-hunting geology. References were made to Augustus Locke's paper on Ore-hunting Geology which had been presented on Monday afternoon, but was not on the list of papers mentioned in the program of events. Mr. Mudd spoke of Mr. Locke's paper and the line of thought suggested. Professor Lawson spoke of the need of training men of insight and aptitude, and their value to the mining industry when so trained. In ore-hunting geology we must recognize that many failures will be made; that many experiments will have to be performed; and that many of these experiments will be failures. Possibly there may be one success in a hundred cases. Professor Lawson spoke of the constructive work that is being done by the United States Geodetic Survey, especially in the study of faults which have become a subject of grave concern since the San Francisco earthquake in 1906. Thanks to a resolution for a budget for this work which was passed by Congress, the Survey has undertaken the measurement of the creep of the earth's crust in the areas involved by the great earthquake. New stations have been established by latitude and longitude and are found not to be coincident with the old ones, showing a slow creeping of the earth's crust. The Survey has established a base line from the crest of the Sierra Nevada Mountains to the Coast Range as a basis to which to refer future measurements.

Professor Jones, professor of mining geology at the Mackay School of Mines, spoke of the work of the prospector, and particularly of his temperament. This school provides short courses for prospectors, which enable them to attack their problems in a more rational manner than when following their former theories.

Frank Sizer spoke of the wasted effort of much of the prospector's work through the lack of education, and said that the prospecting course at the Mackay School of Mines should be very beneficial.

P. Gybbon Spilsbury spoke of the methods of prospect examinations made from his office in Phoenix, Ariz. He has the territory divided into classified districts wherein each prospect is noted with its characteristics. This method, which was also devised and used by Mr. Locke in his work, simplifies and lowers the expense of examinations. On Mr. Spilsbury's staff, there are prospectors to do the preliminary work in following up information of new discoveries. The prospector's examination, if impressions are favorable, is investigated by an engineer. Thus important information is obtained through professional prospectors which otherwise would not be gained.

S. E. Bretherton suggested that, in view of the difficulty in finding new mines, more attnetion be given to areas that have produced mines in the past. The study of the old mines with our present knowledge of ore deposition was a timely suggestion.

Mr. Slosson, who is associated with the new enterprises on the Comstock, briefly reviewed some of the history of the early work in that district. In one of James G. Fair's old reports, mention was made of the milling cost of $26.75 per ton. This may be compared to the present cost of $2.50 to $3.00 per ton. Fair's extraction was stated to be 65 per cent., whereas the present figure is given at 93 per cent. At the time of Mr. Fair's report, the Comstock mills used pan amalgamation developed at the plant. Many complicated situations were presented because of the local rules giving ownership of the tails to the mill that produced them.

D. M. Riordan gave a picturesque account of the early life in the mining camps of Nevada and California, which, coming from one who had personal contact with all phases of pioneer life, was of special interest.

Mark L. Requa spoke in accord with Messrs. Mudd and Locke on prospecting, and also recognized the new type of prospector with some mining school education. Mr. Requa reviewed the early work on the porphyry copper properties, financing the Nevada Consolidated and the railroad to Ely, Nevada.

### Dwight Outlines Institute Activities

President Dwight spoke of the value of personal contact such as these conventions provide. Mention was made of the magazine Mining and Metallurgy, the reason for its publication, and the carrying of advertisements. Canvassing the situation for comparison with the activities of other scientific societies, it was found that out of 100 publications of these societies 75 carry advertisements. Foreign societies also advertise. Colonel Dwight spoke of the policy of the magazine in keeping in touch with the members both at home and abroad.

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THE INSTITUTE PARTY AND THEIR HOSTS AT OATMAN, ARIZ.

SECTION OF PANORAMA SHOWING TWO HUNDRED GUESTS AND HOSTS COMPRISING THE A. I. M. E. PARTY, AT THE COMSTOCK.

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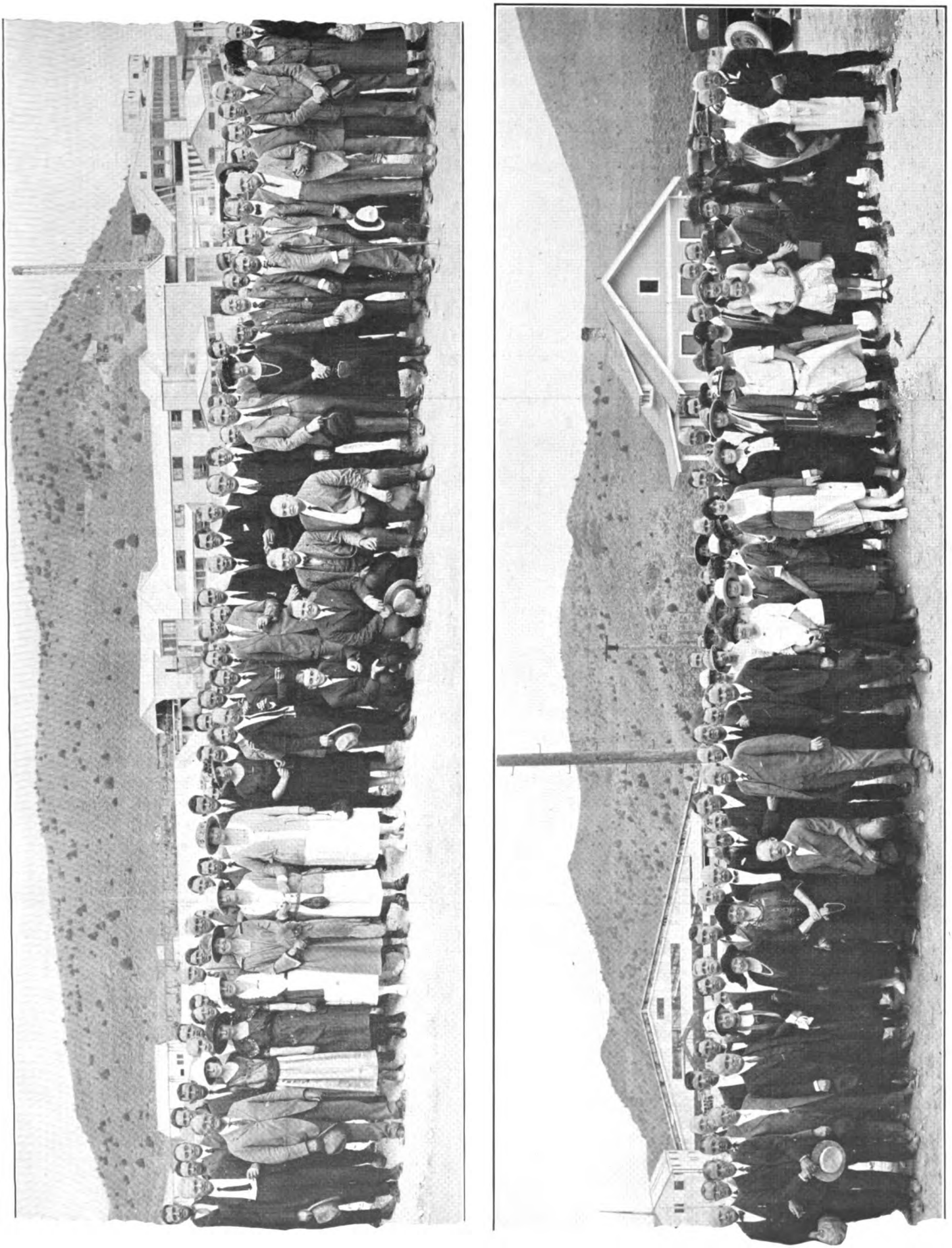

CONCLUDING SECTIONS OF PANORAMA SHOWING TWO HUNDRED GUESTS AND HOSTS COMPRISING THE A. I. M. E. PARTY, AT THE COMSTOCK.

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The iron and steel session was scheduled to meet on Monday morning, but because of the special interest of most of the engineers in the mining meeting, there were not enough present at the iron and steel session to hold a meeting. C. C. Brayton, chairman of the session, advised there would be no further opportunity to convene, as the program for the remainder of the week had been prepared. The papers on the program for this session were: "Neumann Bands as Evidence of Action of Explosives upon Metals," by F. B. Foley, and S. P. Howell; "Effect of Nickel-chromium on Cast Iron," by Richard Moldenke; "Conditions of Stable Equilibrium in Iron-carbon Alloys," by H. A. Schwartz, H. R. Payne, A. F. Gorton and M. M. Austin.

### Petroleum Features

Two papers on petroleum were presented, one by Roy W. Kelley on "Industrial Relation of the California Oil Industries Syndicate," and one on "Colombian Oil Fields," by L. G. Huntley and Shirley Mason.

Mr. Kelley's paper was a discourse on the welfare work done by the syndicate. The Associated Oil Co., Pacific Oil Co. and a few others are represented in this work. The description was replete with human interest, splendidly illustrated by lantern slides and educational to those not familiar with the oil industry. A very prominent part of the welfare work is given to accident, employment, education, library facilities, housing, sanitation, athletics and improvement and substitutes to replace desert environment. Great numbers of statistical data are kept, which are of value in new and permanent improvements. A moving picture showing the general operations, from the drill in the field to the service station, was of special interest. There were numerous discussions complimenting the Syndicate for the high character of its welfare work. It was brought out that much depended on mutual loyalty, frequency of conference, broadness of executives and coöperation.

### Visits to the Universities

President Dwight and Secretary Sharpless, with other engineers, started on Tuesday morning to visit the development work on the Hetch Hetchy project.*

The short trip on Wednesday to the University of California, at Berkeley, was attended by most of the delegation and their wives. There was a luncheon given at the Faculty Club, and later in the afternoon, the guests proceeded to the home of T. A. Rickard, where a most enjoyable tea was served, delightfully closing the program for the day.

Thursday morning found most of the engineers and ladies ready for the trip down the Peninsula to Stanford University. Thanks to Abbot A. Hanks, in charge of automobile arrangements, and to many who generously offered their cars for the occasion, the trip to the university was made in comfort. The guests were met at the entrance by Prof. T. H. Hoover, and Prof. Welton J. Crook. A student was placed in each machine to explain the points of interest on the campus. The quadrangular system of buildings is beautiful and advantageous in movement of classes. At luncheon, Professor Hoover welcomed the assembly and briefly reviewed the aims of the university. He introduced Mr. Roth, the comptroller, who added a further note of welcome in lieu of President Wilbur, who was not able to be present. Many points of interest were visited after luncheon, and at 4:30 the guests were assembled in the Stanford Memorial Church, which is noted throughout the world for the beauty of its Byzantine architecture and mosaics. An organ recital entertained the guests for about half an hour.

A trip to the Selby smelter on Friday was participated in by the engineers who were especially interested in the modern methods employed in its silver refinery.

### Social Affairs

A program for the ladies had been prepared by the San Francisco Section of the Woman's Auxiliary, with Mrs. F. W. Bradley, chairman, and Mrs. Oliver C, Ralston, secretary. A few side trips were made including shopping tours and a visit to quaint and picturesque Chinatown.

Monday evening was the occasion of a most enjoyable time at the home of Mr. and Mrs. F. W. Bradley, where a buffet supper was served to over 300 guests. The expeditious manner in which this multitude was handled (for truly it was no less than a multitude) was a marvel to those present. Any description of this delightful affair could but reduce its charm.

On Tuesday forenoon the entertainment committees announced that Mrs. Sidney Cloeman extended a cordial invitation to the engineers and ladies to attend a luncheon at the Burlingame Country Club down the Peninsula. This was attended by possibly over a hundred, and will remain long in memory even after some events have been forgotten. The setting for this luncheon was as beautiful as careful thought, flowers and service could produce. After luncheon the guests were invited to visit the homes of Wm. H. Crocker and Joseph G. Grant, within a short driving distance of the Country Club, which by artistry of architecture and landscape engineering give a lasting impression of beauty.

### Obligations due San Francisco Committee

Much of the planning of a successful convention is in the background, and is not thought about, therefore congratulations are in order to the entertainment committees, the chairman and secretary of the San Francisco Section. Their efforts, largely unseen, resulted in one of the most successful meetings, professionally and socially, ever held in San Francisco.

* See page 23.

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# The Week in San Francisco and the Homeward Journey

By F. F. SHARPLESS

Secretary, American Institute of Mining and Metallurgical Engineers

ARRIVING at Davis Junction, after leaving Portland, we expected to wait for an hour and a half, but found the superintendent of motive power of the Southern Pacific, Mr. Williams, waiting for us with a car, and were immediately taken aboard this and whisked off to Sacramento. After dinner, we were taken to the railroad shops to see their work in reclaiming scrap steel. We saw them draw off the slag from the electric furnace, and later make a casting.

At about 11 o'clock, we took the train for Reno. A delegation of the Nevada Section, with Mr. Kirchen and Mr. Rives at its head, met us at the station.

Immediately after breakfast, we started for the property of the Comstock Mines Co., where General Bulkeley Wells was to be our host. We had a delightful ride out to the mines and through the old city of Virginia, or through what was left of that old city, reaching General Wells' camp at about 10:30. This contains the newest thing in cyanidation and a remarkably fine iron and concrete mill building.

After a trip underground, we were called to luncheon, where about 250 sat down. The afternoon was spent in the mill, and we were taken to Gold Hill, which is a part of Virginia City, for dinner, again as the guests of General Wells, who made a consummate toastmaster.

Governor Emmet Boyle was the first speaker; he was followed by President Dwight, and then came President William Sproule of the Southern Pacific. A song, "The Engineer," was followed by Senator Key Pittman, Professor Jones of the State University, Mayor Stuart of Reno, and ex-Senator Charles Henderson. The president of the Western Pacific and the president of the Pacific Coast Line were there, also many notable operators of Nevada and California.

## Opening of Meeting in San Francisco

Reaching San Francisco on Sunday morning, Sept. 24, we were met at the Palace Hotel by a contingent of our members, headed by Mr. Bradley and Mr. Fry.

The first session was called by Mr. Burch at the Engineers Club and the room, holding about 150, was filled by the time the chairman's mallet called for order. Luncheon was served at the club, but the crowd that had gathered by this time was so large that many had to go elsewhere.

Two lively afternoon sessions were held. At the mining session, Augustus Locke presented a paper on prospecting which had not previously been announced. Mr. Locke and his associates have devoted a great deal of time to the study and analyses of croppings for the purpose of determining their relation to commercial ore deposits. The description of the methods and results brought about a lively discussion and emphasized the fact that, next to mining ore, members were interested in geology more than any other subject, particularly as to using it as a guide in prospecting work.

In the evening a supper was served to all members and their wives at the home of Mr. and Mrs. F. W. Bradley, where opportunity was given for the eastern members to meet those whose homes are in the west. Music and dancing were enjoyed until a late hour, and the 25th of September, 1922, came to a happy close.

## The Visit to Hetch Hetchy

The Hetch Hetchy water project of San Francisco is one of the big undertakings of the day. It means 400,000,000 gal. of mountain water daily for San Francisco and neighboring cities; it means development of 200,000 electric horsepower with which to pay for a portion of the construction and operating expenses. The installation of the plant has called for the highest skill from all classes of engineers. Civil engineers, hydraulic, electrical, mechanical and mining engineers have all been doing their share; the latter devoting their attention more particularly to the 18 miles of tunnel through which the water will pass on its way to the bay. The storage reservoirs, of which there are three, are in the most picturesque part of the Sierra Nevada mountains, where bold bare granite peaks stand out in contrast with mountains covered with a rich growth of pine and cedar.

When an invitation was extended to a party of mining engineers to visit this project as the guests of the City of San Francisco, there was naturally a quick response and a keen desire to take advantage of the opportunity. The members who were to take this trip met at the ferry at 8.40 on the morning of the 26th. W. A. Eckart, from the office of the chief engineer, M. M. O'Shaughnessy, accompanied the party into the mountains.

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Across the San Joaquin Valley at this time of year is rather an uninteresting ride. Not until the foothills are reached and climbing begins is one inclined to give his attention to the white and live oaks in their setting of yellow brown hills. We traveled through well known placer camps, where 30 years ago we climbed slowly in a Concord stage with its four horses and clouds of dust. At 4 p.m. we reached the Rattlesnake Creek, near the site of the lowest power house, where a reservoir is being built to hold a two days' supply of water at the lowest exit of the 18-mile tunnel. An inspection of this dam, which is built with a light concrete core backed by hydraulic filling and faced with rock filling, lasted for an hour. Dinner was served at the camp boarding house and we learned how well the men on the job are being cared for by the city.

### Under Canvas at Groveland

Shortly after dinner, a railway automobile arrived, to take us up the road to Groveland for the night. Here the executive offices of the engineers and consrtuction company are placed. Cots had been prepared for us in the tent camp and within half an hour after our arrival we were all sound asleep.

On Wednesday morning, after inspecting machine shops and warehouses at Groveland, we took our railway auto and started again up the line, with its short sharp curves, twisting around the hills which were growing higher and steeper and more completely covered with merchantable timber. Our first stop was at the Big Creek shaft, an intermediate point on the tunnel line. From the bottom of the shaft the tunnel has been driven over a mile both north and south. The sinking of this shaft was accomplished with some difficulty. It is only a two-compartment shaft and rather small for pumping 2000 gal. per minute, an amount that has been handled at various times during the sinking. Grouting of the seams in advance of sinking was constantly necessary and, the seams being vertical and quite open, progress was slow.

Lunch was served at South Fork where the aqueduct tunnel is reached by a crosscut from above the Tuolumne River, and then we were off again in our automobile, at 1.30 reaching the top of the grade above the intake of the tunnel, the upper end of the 18-mile excavation. We were lowered for 1300 ft. on an 85 per cent. incline—not a very steep incline for a mine, but standing out in clear daylight, and with no stations that we could see between top and bottom, we stopped just a moment to look around to see whether there was any other way of getting down into the canyon. There was not, so we stepped aboard a flight of stairs on wheels and were lowered to the level of the river. We had a two-mile ride into the tunnel face where the Myers-Whaley machines are doing the mucking, and where 20 ft. advance per day is frequently made.

Near the intake, the first power unit has been established, which secures its water supply from Lake Eleanore. This portion of the project is practically completed, furnishing power all along the tunnel line and selling surplus to one of the power companies. When the shadows were getting long we were hoisted out of the canyon over the same route we had used in entering it and proceeded to Mather, where the lumber used in the project is being sawed. Here we were quartered for the night at the Hetch Hetchy Lodge of the Yosemite Co., a large living room and kitchen under one roof, surrounded by a number of small cabins located in a fine growth of tall timber that has not yet seen ax, saw or fire. Sugar pine, yellow pine and cedar up to 4 ft. in diameter stretched their tops far above our head. In the center of this natural park some trash and logs had been placed in a cleared spot ready for the match after dinner.

With plenty of bedding and not a sound or breath of wind to break the stillness of the night, we slept until our program said, "Breakfast, 7.30." No one was missing as we sat down at a table loaded as though for a

Group that visited Hetch Hetchy, after inspection of the Big Creek shaft.

Christmas dinner. Something in the mountain air appears to whet the appetite, and the cooks up there know it; "Continental" breakfast has no place on the bill of fare at Mather.

### In the Hetch Hetchy Valley

Our auto carried us again out into the canyon of the Tuolumne, far up which we could see the partly completed dam which is to block the water at the lower end of the Hetch Hetchy Valley. We have read and heard much respecting the destruction of this public playground, from the floor of which are seen some of the finest mountain effects of California. True, this camping ground will be destroyed, and the pasturage of perhaps a section or more in extent, but the flat land that will be converted into a lake measures only about a mile wide by two miles long—it is but a tiny speck in this large preserve. When filled, this lake, among rough rocks and green peaks, will be accessible to hundreds over the railway now reaching the dam site. Heretofore this rough bit of country has been seen only by the few campers who have had the time to reach it by means of pack animals or afoot.

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The dam is a big work, but in the vast array of nature's structures standing all about it, it becomes a diminutive undertaking. Four fifths of the concrete is already poured and many of the gates are in position. It will probably be completed during the coming winter; it will be completed in so far as present plans are concerned. It is so constructed that by placing additional concrete on the downstream face and upon the crest it will retain all of the average run off of its watershed, nearly 700 sq. miles in area. It will cost about $5,500,000. By Christmas there will have been poured about 375,000 cu. yd. of concrete and by spring, when the snows melt, there will be held behind it 67 billion gallons of water, upon which the irrigation district will have first claim.

From the concrete block, we were saved the annoyance of a climb up to the camp above us. The work is served by a crab on a 2⅛-in. cable. We were invited to step into a large lattice-work crate held at the corners by four chains. All set, and we were quickly hoisted 200 ft. straight up in mid air, and then brought safely to land a few yards from our dining room.

Dinner disposed of, we spent an hour at Observatory Point, just gazing at the great valley with its grey rocky walls extending for miles to the east. We reluctantly turned our backs on this interesting and wonderful sight and began climbing out of the valley in our little motor car. No stops were made on the return journey except for the night. We had only to sit and enjoy nature's panorama as our little car caused it to pass rapidly before our eyes.

While the President and the Secretary had been in the mountains, those who had remained behind in the city had been amply provided with entertainment, even beyond that noted in the program which had been circulated in advance of the meeting.

### Entertainments in San Francisco

On Tuesday morning, the 26th, there was a tour through Chinatown for both the men and the women of the party, followed by a luncheon given by Mrs. Sidney Cloeman at the Burlingame Country Club. After the luncheon the party was driven through the Crocker and Grant estates.

On Wednesday the party was taken by automobile to the University of California. Small groups, each headed by a student, were taken through the Greek theater, many of the University buildings, and up to the Campanile, from which a splendid view of the surrounding country was obtained. Luncheon was served at the Faculty Club, after which the Skyline drive was taken, through Oakland and back to the university. Later tea was served at the home of T. A. Rickard. Mrs. Rickard and Professor Weeks of the university entertained the guests with music and recitals.

On Thursday, our hosts again provided automobiles and drove a number of our members to Leland Stanford Jr. University where a committee, of which Prof. Theodore Hoover was chairman, conducted the party around the campus and through the various buildings. A delicious luncheon was served to about 80, at the University Union. In the afternoon the women were shown the Art Gallery and Museum while the men were taken through the Engineering buildings. A special organ recital was given for the visitors before they returned to the city.

On Friday we were entertained at luncheon by Mrs. Requa and Mrs. Burch at the home of Mr. and Mrs. M. L. Requa. Madam Requa, now in her 95th year, also acted as hostess and was constantly the center of interest with her brilliant conversation. The Woman's Auxiliary formed the subject of discussion after luncheon, both Mrs. Dwight and Mrs. Burch speaking of its activities. Mrs. Rickard and Mrs. Hutton entertained with music until it was time for the distant members to say farewell to their San Francisco hosts.

Theoretically, the California meeting was a pay-as-you-go, Dutch-treat meeting. On a few occasions, we did pay for our luncheon or a street car fare, but the hospitality of our San Francisco members seemed always to have had the better of them. More was done for the visiting members than they could possibly have expected, and the 126th meeting will long be remembered as an event in Institute history.

### A Day in Los Angeles

On the morning of Oct. 1, flowers and fresh dates as well as automobiles were waiting for the President's party at breakfast. Los Angeles hospitality was to be no less real than that in other cities through which we had passed, and Sunday was to be a work day for our hosts. No fixed program had been arranged for the morning, but each driver, after consulting his guests, laid out his own course. A number went first to the Museum where are mounted many skeletons of prehistoric animals taken from the asphaltum beds of La Brea, within the city limits. Later, we were shown the pits from which the bones had been taken and which will furnish many thousand more skeletons before they have yielded all of their stored wealth of ancient fauna.

A drive through the residential portion of Los Angeles and through famous Hollywood lasted until one o'clock, when we were driven to the Wiltshire Country Club for luncheon. Nearly a hundred men and women had gathered there to welcome us to Los Angeles. Many familiar faces were among our hosts. Los Angeles appears to be the Mecca of mining men, for not only were all parts of the United States represented but also South Africa, Australia, Russia and other distant lands where mining is done. An ample luncheon was followed by short addresses by D. B. Meyers, the President and the Secretary.

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After luncheon, while the men smoked their cigars, Mrs. Dwight spoke to the women of the party about the work of the Women's Auxiliary. Then we were driven to our train, where a special car was waiting to take us to Kingman.

### Hospitality in Arizona

Hospitality in its most genuine form had been shown to us all along the way, but that shown by Kingman and Oatman certainly merits special mention. Before four o'clock in the morning, our friends in Oatman had started for their drive to Kingman—a drive of 30 miles before breakfast! We arrived at Kingman at about 8 o'clock and found our good friends, headed by Mr. Billings, awaiting our arrival.

After breakfast, a straightaway drive of 15 miles across the Sacramento Wash, over a splendid automobile road, brought us to the foot of the hills in which Oatman is concealed, and a still better mountain road took us up an easy uniform grade into the camp where the officials of the operating companies and their wives were waiting for us. The rugged mountains surrounding the Tom Reed, Goldroad, United Eastern and other well known mines, with their rich and vivid coloring, were a fitting prelude to the Grand Canyon which we were to see on the following day.

The men of the party were taken down the Big Jim shaft, and at the 3rd level were taken up into the main stope where they had an excellent opportunity of examining a fine back of ore 20 ft. wide and 300 ft. long. Luncheon was served in the Club House by the ladies of Oatman, and we were then taken through the United Eastern mill, an up to date cyanide plant running smoothly and with so few mill men that one had to hunt to find any. Our inspection ended at the melting house where we witnessed the pouring of a $7000 bar of bullion.

The drive back to Kingman in the cool of the evening and with the setting sun casting its long purple shadows among the distant mountains was most delightful. Dinner was served at 8 o'clock, the party being the guests of the Northern Arizona Section. Owing to train connections, only a few moments were given to addresses, which were made by R. W. Moore and R. S. Billings, chairman and secretary of the section, by President Dwight and by Mr. Barron. A few minutes later we were forced to say farewell, but it was done in the regular hospitable manner of the West, with all of our hosts on the platform wishing us God Speed.

The 3rd and 4th of October were spent at the Grand Canyon. This was the only time during the trip that we were not the guests of some section.

On the morning of the 5th, we arrived at Phoenix, where we were met by P. G. Spilsbury and C. F. Willis, who had arranged that we were to be the guests of the Chamber of Commerce. Automobiles were placed at our service and, accompanied by several of the distinguished citizens of Phoenix, we were driven through the irrigated valley. Luncheon was served at the San Marcos Hotel at Chandler.

At 7 o'clock we were again taken in hand by the members of the Chamber of Commerce, who drove us to the Country Club for dinner. The Mayor and a number of the prominent citizens with their wives received us. The table, which had been set out of doors, was illuminated by a brilliant full moon, and a delightful evening was passed in social intercourse.

Early on the morning of the 6th, we took automobiles and started over the Apache Trail toward the Roosevelt dam. A portion of the road was rather rough, but the scenery along the trail was ample compensation and removed all thoughts of weariness. Half an hour was spent at the dam, and we then drove into Globe on schedule time, finding a committee of our local members waiting for us at the hotel.

The coöperative mine rescue station was our first stop the next morning. This station is one of the interesting features of the district. It is supported by the various mines of the camp in proportion to the number of men employed. A very complete outfit for fire fighting and rescue work is held on an automobile, ready to start at a moment's notice to any point in the district, the farthest of which may be reached in less than 25 minutes. The entire equipment on this truck is examined daily and is always in perfect order. Also, at each camp a fire-fighting apparatus is maintained which is serviceable for a half-hour period and is ready for instantaneous use should occasion arise.

Our next stop was at the Inspiration mine. There we were taken underground by Mr. O'Brien, on the Otis elevator, and shown the working of the automatic hoist. The next stop was the International smelter and from there we went to the Miami mine, where luncheon was served at the club house, F. W. Maclennan presiding. In the afternoon, we were shown through the Miami mill and were then driven to the Old Dominion mine and up over Copper Hill to see the lay of the properties on the Old Dominion vein.

### Final Meetings at Globe

Dinner was served at 7 o'clock, the Southern Arizona Section acting as host. The officers of the Southern Arizona Section, with the exception of Mr. Barkdoll, were not able to be present, but Mr. Barkdoll, ably assisted by Mr. McBride, Mr. Maclennan and Mr. O'Brien, succeeded in bringing about one of the most delightful and interesting meetings of our entire trip.

With the goodbyes of our hosts at Globe, the trip of the President to San Francisco and the many local sections came to an end. The energy and interest shown by the members of every section gave evidence of the deep interest taken in Institute affairs. The inspiration instilled by the President's visits and talks will undoubtedly be helpful to each of the sections, and such a trip is well worth repetition.

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# Rescue Work at Argonaut Mine Fire of 1922*

By BYRON O. PICKARD

District Mining Engineer, United States Bureau of Mines

AT MIDNIGHT of Sunday, Aug. 27, 1922, a fire was discovered in the main shaft of the Argonaut mine, Jackson, Cal. With the exception of a shift boss and two skip tenders who escaped, the entire night shift of 47 men was trapped in the mine and entombed for 22 days, when the bodies were recovered.

The entombed miners made a valiant but fruitless effort to save their lives. Rescue crews toiled strenuously day and night for 21 days to save the entombed men, only to find they had arrived too late.

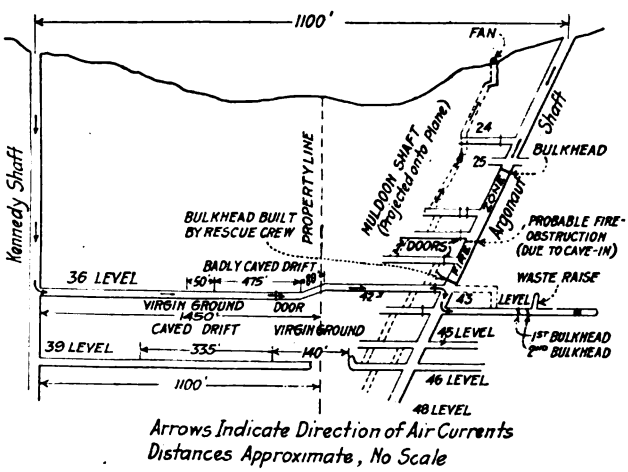
From the experiences of the entombed miners and of the rescue crews, valuable lessons may be learned to prevent future catastrophes.

## Description of Argonaut Workings and Ventilation

At the Argonaut mine there are two shafts, called the Argonaut and the Muldoon shafts. The Argonaut shaft is the main three-compartment working inclined shaft and extends 4900 ft. to the bottom of the mine. From this main shaft levels are driven at 150-ft. intervals. Two compartments of the shaft are used for hoisting ore, men and materials. The third compartment contains a straight ladder-way, compressed air line, pump columns, water line for drilling and electric lines for power, lighting and telephones.

The Muldoon shaft proper is 800 ft. deep below the surface. At this depth there is a horizontal offset to connect with a raise from the Argonaut 2400-ft. level. At this connection there is a second horizontal offset to connect with a raise from the 3700-ft. level. From this point to the lower levels, raises extend only from level to level, at each level the connection being through horizontal offsets. Actually, therefore, the Muldoon shaft is only 800 ft. deep and the remainder of the second exit connection is composed of raises and drifts. The second exit, as the Muldoon shaft and connecting raises will be called in this article, is composed of two compartments; one being used for a ladder-way, the other principally as an air-way.

On the surface at the collar of the Muldoon shaft, there is a suction fan which normally exhausts about 35,000 cu. ft. of air per minute from the mine workings. This air is pulled down the Argonaut shaft through the lower levels and is returned through the second exit raises and connecting drifts. To prevent short-circuiting of the air through abandoned levels, wooden doors have been placed at every level from the 4500-ft. to the surface. These doors are kept closed by the suction pressure of the ventilating current and, while there is considerable leakage, the resistance is sufficient to insure delivery of limited amounts of fresh air to the hot lower workings, where the principal work of the mine was being prosecuted before the fire. The release of the suction pressure, or reversal of air current, would cause many of the doors to open and permit short-circuiting of air.




ARGONAUT-KENNEDY FIRE AND RESCUE WORKINGS.

## Bureau of Mines Mine Rescue Facilities on Pacific Coast

The United States Bureau of Mines maintains a rescue safety station at Berkeley, Cal., which serves the mines of California. From this station as headquarters, there is operated a large automobile truck with a special body designed to carry oxygen breathing apparatus, oxygen tanks and other emergency equipment. A light truck is used as an auxiliary. Two trained men, a foreman miner and a first-aid miner, comprise the crew that operates the station.

At the time of the fire there were 16 serviceable self-contained oxygen breathing apparatus and a large supply of oxygen and regenerating material at the station.

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Also serving the Pacific Coast district, in which California is included, is a specially designed all-steel railroad car called the United States Bureau of Mines Mine Rescue Car No. 1. This car operates out of Reno, Nev., as headquarters. Its crew consists of a foreman miner, a first aid miner and a cook. At the time of the fire there were 10 serviceable self-contained oxygen breathing apparatus on the car and a large quantity of apparatus supplies. The Berkeley Safety Station and Rescue Car No. 1 are under the immediate direction of a district engineer, whose headquarters are at Berkeley, Cal. On the staff of the district engineer is a district surgeon who is also headquartered at Berkeley.

There are United States Bureau of Mines safety stations and cars in practically all of the important coal and metal-mining districts in the United States, the group control of the cars and stations being under the chief engineer of mine safety service at Pittsburgh, Pa., who is responsible to Director H. Foster Bain, at Washington, D. C.

### Record Mobilization of Rescue Apparatus

Mining companies in California are aware of the availability of the Bureau's emergency service. Consequently, when the Argonaut fire was discovered the mine management telephoned to the Bureau's district engineer at 3 a.m., Aug. 28, stated the conditions and asked for all the help the Bureau could possibly give. By 5 a.m., the Berkeley Station crew was assembled, the light truck loaded and the crew had left. They drove the 130 miles by 10 a.m. The large truck loaded with supplies, driven by E. W. Bullard of San Francisco, assisted by G. M. Wiles, a University of California student, both of whom volunteered for service, followed soon after.

Car No. 1 was stationed at Elko, Nev., when its foreman miner received orders from the district engineer to proceed immediately to Jackson "Account of mine fire men entombed." Unfortunately, the crew encountered a bad washout en route and was delayed several hours, but the Southern Pacific railroad officials of their own accord furnished special fast trains and rushed the car to the Amador Central Terminal at Ione, Cal., where the Amador Central had a special engine waiting to hurry the car to Martell, which is Jackson's nearest railroad point. The car arrived at Martell at 5 p.m., Aug. 29, making the fastest time on record for a rescue car going to an emergency.

The Bureau's district engineer and surgeon went to the mine by private automobile, arriving at 1 p.m., Aug. 28.

On Sept. 1, the district engineer realized that more oxygen apparatus would be required and wired his chief at Pittsburgh for assistance. Mine Rescue Car No. 2, with 16 oxygen breathing apparatus and supplies and with a crew identical to that described for Car No. 1, was immediately dispatched from New Mexico and arrived at noon, Sept. 3. This made one of the largest representations the U. S. Bureau of Mines has had at a metal-mine fire.

The Argonaut mine is served by a coöperative company mine rescue station operated jointly by several mines in Amador County. The foreman of this station, with three additional apparatus men and with five sets of oxygen breathing apparatus, arrived at the Argonaut at 5 a.m., Aug. 28.

### Discovery of Fire

The statements under this heading are taken from the transcript of the testimony at the coroner's inquest.

The Sunday night shift of 43 men, in charge of a shift boss, was lowered to the 4500 station between 6 and 6:30 p.m., Aug. 27. The men were distributed to the various working faces on the 4500, 4650 and 4800 levels. At 11 o'clock, four additional men came to the lower levels and were assigned to special development work. The underground men ate their lunches at the stations at the usual time—about 11 o'clock—and left the stations to go to their working places. The shift boss and two skip tenders, who were not included in the total of 47 men above mentioned, decided to clean out a waste chute on the 4200 level. During this work one of the skip tenders smelled smoke. They immediately rushed to the shaft, and noted that the shaft at this point was full of smoke. This was about half past eleven. The shift boss immediately signalled for the skip and he and the two skip tenders were hoisted through the fire to the 3000 level. Two hanging-wall sets, 10 ft. below the 3000 station, were burning at this time. After being hoisted to the surface, the shift boss announced the discovery of the fire and as soon as assistance could be secured efforts were made to extinguish it.

### First Attempts to Extinguish Fire

Attempts to put water on the fire from water kegs, carbide cans, skips and station tanks were continued all through the night and the following day, but the efforts with the fire-fighting equipment available were unsuccessful.

Within half an hour after the discovery of the fire, the signal lines, telephone lines, and water and air pipes were burned out and there was no communication with the lower levels. For this reason, the early attempts at fire fighting were desperate. It was found that while there was little smoke above the fire there was considerable steam and it was impossible to get closer than 200 ft. to the fire at any time. An exploration by apparatus men was made at midnight of Aug. 28 to determine the exact location of the fire. This crew reached the 2700 station and found themselves completely enveloped in smoke and steam and the temperature so hot that it could not be endured for more than a minute. They believed that the fire was immediately below them. The district engineer immediately went into conference with a representative

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of the Industrial Accident Commission and the Argonaut mine manager.

It was unanimously agreed by the conferees that there were but three possible chances of rescuing the entombed men; namely, (1) rescue-apparatus men going down the Muldoon shaft; (2) controlling the fire in the Argonaut shaft; and (3) driving connections from the adjoining Kennedy mine. As the fire in the Argonaut shaft was beyond immediate control, and even if controlled considerable time would be necessary to repair it so that rescue crews could pass through the fire zone safely, it was believed that all other chances of rescuing the men should be considered seriously. The matter of the apparatus crews going through the Muldoon shaft was given first consideration.

As stated formerly, the Muldoon shaft is straight to about the 800 level; then, with an offset, extends to the 2400 level. From here to the bottom levels the connection is through a series of raises or intermediate shafts, which are offset from one another. That is, these raises are not in a straight line; hence, hoisting is not possible through the Muldoon shaft to the bottom part of the mine. The raises leading to the Muldoon shaft and the shaft itself are equipped with ladders for escape, but even in fresh air the most hardy climbers would require a matter of hours to climb to the surface.

### Muldoon Shaft Rendered Unavailable

It was also pointed out formerly that the air from the mine returned to the surface through the Muldoon shaft; consequently, at the time of the fire the return air was carrying poisonous gases from the fire, and within a very short time after the fire was discovered the air in the Muldoon shaft was so noxious that no one could live in it for more than a few minutes. With smoke and gases present no one could climb far; hence, when the fire occurred in the hoisting shaft, preventing hoisting from the lower levels, unconfused miners naturally would not attempt to climb out such a long distance through the smoke-filled Muldoon raises and and shaft. Their natural inclination would be to barricade themselves in stopes or the inner parts of the levels.

Exploring the lower levels of the Argonaut mine by mine rescue crews wearing oxygen breathing apparatus would involve going down the second exit raises and drifts and then climbing back, all within two hours to keep within the working limit of the breathing apparatus. It was pointed out by the district engineer that the oxygen and chemicals of the self-contained oxygen breathing apparatus would be consumed before the trip was half made. It certainly would be sending men to their death to undertake such exploration, as it would require four or five hours for men breathing good air without the apparatus, which weighs about 40 lb., to make such an exhausting trip. The conferees therefore decided to abandon exploration through the Muldoon shaft.

They next considered controlling the fire in the Argonaut shaft. It was decided that this work should be done by men wearing oxygen breathing apparatus, as numerous cave-ins were occurring in the shaft and the heat and the smoke in the immediate vicinity of the fire were intense. Accordingly, further fire fighting in the Argonaut was turned over to the U. S. Bureau of Mines and the coöperating company mine rescue men.

Earlier in the day E. C. Hutchinson, president of the Kennedy Mining and Milling Co., owning the Kennedy mines, whose workings are in the immediate vicinity of the Argonaut, proposed to representatives of the Industrial Accident Commission that plans be considered whereby a connection could be made to the Argonaut lower workings from the Kennedy side.

### Executive and Advisory Committees

The chief representative of the Industrial Accident Commission, H. M. Wolfin, superintendent of safety, therefore decided to call into conference the management staffs of the Argonaut and Kennedy mines, the several local mining superintendents and mining engineers who had volunteered their services, representatives of the Industrial Accident Commission and the district mining engineer of the United States Bureau of Mines. The Argonaut management made the statement that it felt it was necessary to take advantage of all of the volunteer assistance and would be glad to do anything that seemed feasible to rescue the entombed men.

It was decided at this conference to turn over all rescue operations and administration to an executive committee consisting of three men, namely, V. S. Garbarini, manager of the Argonaut mine, E. C. Hutchinson, president of the Kennedy company, and F. L. Lowell, mining engineer representing the California Industrial Accident Commission. Garbarini was made chairman and Lowell, secretary. An advisory committee, consisting of all volunteer superintendents, mining engineers, and state and Federal representatives was accepted by the executive committee. The executive committee authorized the immediate driving of connections from the Kennedy mine and decided to continue the fire-fighting operations in the Argonaut shaft.

### Driving the Kennedy Drifts

Daniel Harrington, supervising mining engineer for the U. S. Bureau of Mines, and in charge of the metal-mine ventilation work for the Bureau of Mines, was telegraphed for to assist the district engineer and to advise the executive committee on the ventilation problem. He arrived on Sept. 4.

The Kennedy main shaft, which is vertical, is 1100 ft. horizontally from the collar of the Argonaut shaft. Both mines are operating on ore shoots which are closely allied and in some places presumably are identical. Some of the upper workings of the two mines connect,

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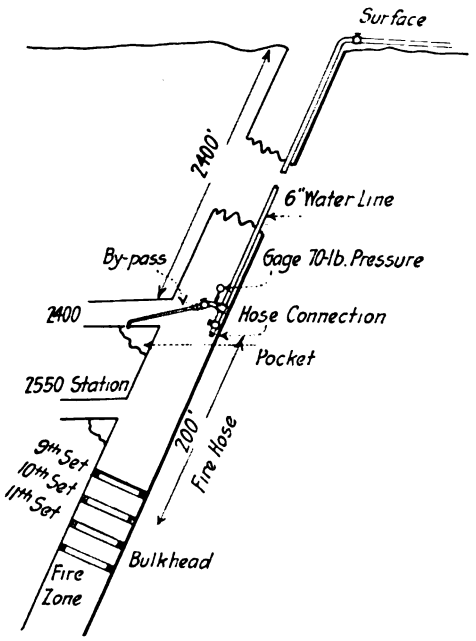
but the lower levels do not connect. In March, 1919, the Argonaut mine experienced a fire in its workings which spread into the Kennedy mine for a considerable distance. In order to completely extinguish the fire, it was deemed necessary to flood both mines. The mines remained under water until April, 1921, when both were unwatered and operations were later resumed. The flooding of the mines caved most of the Kennedy workings in the immediate vicinity of the Argonaut boundary line and as there was no immediate use for them they were not reopened.




WATER LINE AND HOSE CONNECTIONS USED IN EXTINGUISHING THE FIRE.

The 3600 and the 3900 levels of the Kennedy mines were decided upon as the best places to make connections with the Argonaut workings. The 3600 level of the Kennedy would have to be reopened for a total distance of 530 ft. of caved workings and rock, of which 130 ft. would be virgin rock, 80 ft. of the 130 being a raise to connect with a drift driven by the Argonaut from the 4200 station to the boundary line. The 3900 Kennedy level required the opening of 475 ft. of rock and caved ground, 140 ft. of which would be through virgin rock and would connect with a stope in the Argonaut workings above the 4650 level. The work of driving these drifts consisted of the tedious and difficult task of going through old caved ground, taking out not only the mud but removing timbers and in many places retimbering and even spiling had to be resorted to. It was very difficult work. The air and water lines had to be brought into the face and often the temperature exceeded 90° in an atmosphere that was practically saturated. The total distance from the Kennedy 3600 station to the Argonaut connection exceeded 1450 ft.; the 3900 drift was practically straight and was about 1100 ft. to the Argonaut boundary line.

Volunteers from the Kennedy, the Argonaut and from other mines on the Mother Lode were used in the work. The 3600 level was gone through after 21 days of concentrated effort on the part of the miners and bosses. The 3900 level was within a few feet of breaking through but was abandoned when the 3600 broke through on account of the possibility of encountering water in the lower levels of the Argonaut.

### FIRE FIGHTING IN THE ARGONAUT SHAFT

As soon as the executive committee gave the apparatus men in charge of the U. S. Bureau of Mines permission to control the fire in the Argonaut shaft, calls were sent in to several California and Nevada mines for mine rescue men. The following mines sent crews: The Morgan-Melones mine, seven men; Empire mine, eight men; North Star Mines, five men; United Comstock mines, of Gold Hill, Nev., five men; University of California, College of Mines, six men.

Orr Woodburn, director of the Globe-Miami Coöperative Mine Rescue Association, Globe, Ariz., also went to the Argonaut and volunteered his services.

The mine rescue men were divided into crews of five men each and assigned to shifts. The Empire mines crew brought with them five oxygen breathing apparatus; the North Star mine brought two apparatus. All of the oxygen breathing supplies, which had been assembled in the western states by the U. S. Bureau of Mines, was ordered sent to Jackson and, in addition, sufficient oxygen and regenerating material were purchased by the Argonaut Mine Co. to insure continual apparatus work for several days.

The total of the mine rescue apparatus available were 42 from the U. S. Bureau of Mines and 12 from California mining companies, making a total of 54 sets of self-contained oxygen breathing apparatus. This was the greatest number of breathing apparatus that was ever assembled at one time in California.

Including apparatus men from the Argonaut mine and several local volunteers, there were available at one time for the fire-fighting operations in the Argonaut shaft 60 men, most of whom formerly were trained by the U. S. Bureau of Mines in the use of self-contained oxygen breathing apparatus.

As before stated, there were numerous falls and cave-ins in the fire zone and when one occurred it drove the gas and smoke up the Argonaut shaft. The apparatus men found it difficult to work in the smoke and steam from the fire zone, so it was decided to take advantage of the suction pressure through the 2400 south drift connection of the Muldoon shaft. A new door was built by fresh air men (under the protection of apparatus men) in the 2400 south drift near the station and a 13-in. galvanized pipe inserted through the bottom of the door. This 13-in. pipe was carried down the Argonaut shaft by the apparatus men to a point a few feet below the 2550 station. It was found that immediately the smoke and steam in the vicinity of the pipe was

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cleared. It therefore was decided to extend the pipe down the shaft as far as possible.

The fire was discovered 12 sets below the 2550 station. All the timbers below this point had been burned out as far as could be seen with the lights available.

It was then decided to extinguish the fire by water. To do this necessitated attaching a hose to the 6-in. pipe column at the 2400 station and carrying the hose 200 ft. down to the fire zone. To eliminate the excessive pressure a valve was put in at the collar of the Argonaut shaft and a controlling valve and a by-pass put in at the 2400 station. A pressure gage was inserted and when the water was turned on the valves with connecting by-pass were so regulated that the pressure at the 2400 station did not exceed 70 lb. Apparatus crews were stationed at the 2400 station and at points between the 2400 and the 2500 levels and two apparatus men worked on the nozzle. Through their joint efforts water was played on the burning timbers for several minutes and the upper fire limit temporarily extinguished at a point 60 ft. below the 2550 station.

The fire area was patrolled by apparatus men at frequent intervals. Sparks were frequently noticed so it was decided to again hose the fire zone. This was done, and the fire was watched carefully during the rest of the night. The following morning it was decided to prevent fresh air from going into the fire area and a bulkhead was put in by apparatus men two sets above the upper limit of the fire zone. This bulkhead was constructed of 3 by 12-in. plank and carefully covered with tar paper, all cracks being sealed with clay. It was necessary to patrol the bulkhead every two hours for several days to keep the clay wet and to be positive that there was little leakage. It is felt that the bulkhead assisted materially in the eventual control of the fire, and prevented spreading.

### Shaft Blocked by Caves

That the inclined shaft was blocked due to falls of timber and rock was taken for granted, as there was very little circulation of air through the main shaft before the 2500 level bulkhead was put in.

About 12 hr. after the discovery of the fire, a heavy cave was heard in the shaft. Soon after that the volume of air exhausting through the Muldoon was decreased from the normal 35,000 cu. ft. per minute to about 12,000. Anemometer readings in the return air at the 2400 south drift indicated that less than 4000 cu. ft. per minute was being exhausted from the workings below this point; that is, 8000 cu. ft. of air was being pulled from workings above the fire and was diluting the fire gases.

At a conference between Mr. Wolflin and the district engineer, it was decided that an accurate analysis of the return Muldoon air would aid materially in the intelligent handling of the fire. Also, many of the miners and others were anxious to go down the Muldoon shaft. It was hoped that if such persons could see the analyses of the air in the Muldoon shaft, it would be easier to persuade them that breathing the air would be suicide. It was decided that Dr. L. H. Duschak, consulting chemist of the Industrial Accident Commission, should be detailed to take care of sampling and gas analysis. With the exception of the first 24 hr. of the fire, Doctor Duschak assembled data upon the return air at the collar of the Muldoon shaft, at the 2400 south level connection with the Muldoon, and at other places where samples could be taken.

### Gas Analysis and Geophone Listening

The carbon monoxide content was frequently as high as 1 per cent. The oxygen content of the return air was as low as 12 per cent.; the carbon dioxide reached from 5 to 7 per cent. This gaseous condition continued for about three weeks; in fact, it was only about Sept. 15 that depreciation in the carbon dioxide was noted. About Sept. 17, the return air through the Muldoon was close to normal, proving that there was very little gas going through the fire zone. It is interesting to note that a M.S.A. carbon monoxide detector was used frequently to check up Orsat determinations with very satisfactory results. Both were checked by using a canary bird.

Fan pressures were measured carefully; also, the pressures of the several bulkheads and doors that had been constructed for controlling the fire; and not until the Kennedy 3600 level broke into the Argonaut level was there any variation noticed in the fan and underground pressures. When the break through was made, pressures at all points decreased instantly, and volumes at the Muldoon fan increased to 23,000 cu. ft. per minute.

It was persistently rumored that some one in the Argonaut was trying to signal by blasting. While it was believed that this could not be possible, it was decided to use U. S. Bureau of Mines geophones for listening purposes. Consequently, crews were arranged under the immediate direction of C. H. Fry and L. H. Duschak of the Industrial Accident Commission and continuous observations were made in the south drift of the 4050 level of the Kennedy shaft. Fry in his report states:

> The dropping of water and the vibrations from the work in that part of the mine made it difficult to differentiate between the various sounds except those that were very distinct, such as drilling and blasting. Experiments showed that hammering on solid rock at 305 ft. from the geophone was not recognized when a drill was running at a distance of 510 ft. Fifteen men were used in the tests and it was found that some men were able to differentiate between sounds much more readily than others. After tests lasting 51 hr., the work was stopped, as it was believed that it could not be of any assistance toward recovery of the men in the Argonaut mine without interfering with more pressing work. The tests showed conclusively that with the amount of work that was being done in the Kennedy mine the geophone would not give desired definite information (or conditions in the fire zone or signalling of entombed men in the Argonaut) for to get this information it would be necessary to stop the work in the drifts on the 3600 and 3900 levels of the Kennedy mine.

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It is hoped that the complete geophone report will be published at a later date, as some interesting data were assembled.

In anticipation of the break through, the executive committee placed the rescue and recovery work in the Argonaut mine in charge of the Bureau's district engineer and he was given full authority to prosecute this work as was best deemed advisable. Accordingly, the following organization was perfected: director of rescue operations, B. O. Pickard; consultant, Daniel Harrington; surface representative, H. M. Wolflin; underground surgeons, Dr. C. E. Kindall and Dr. E. E. Endicott; superintendent apparatus teams, R. B. Hecox; superintendent fresh-air crews, C. H. Fry; underground assistant to director, Orr Woodburn; superintendent mine rescue apparatus station on surface, H. Crouch; superintendent first aid, recovery and other supplies, E. Bullard.

The apparatus crews were made up of a captain and four men to each crew and divided into two groups of two crews each. Group A was to enter the Argonaut workings first and be supported by group B in reserve at the fresh-air station underground. Group C was to support group B and remain in reserve on surface, going underground to the fresh-air base when group B relieved group A in the gaseous workings. The remainder of the apparatus men were held as substitutes.

The fresh-air crews were organized by Fry, with Foreman Sinclair of the Kennedy mine and Shift Boss Murphy of the Argonaut mine, as assistants. The fresh-air crews were to support the apparatus crews and do such work in fresh air as was necessary and as would not interfere with the work of the apparatus crews. They were expected to carry the drinking water from the Kennedy 3600 station to the fresh-air base and to bring in such timber and other supplies as might be needed by the apparatus men. It was also the duty of the fresh-air men to keep the drifts in repair to fully protect the apparatus men who were working ahead of them. Everything was done to coördinate the work of the apparatus and fresh-air men.

### Conditions and Circumstances at the Break Through

At the time of the break through, there were 35 apparatus men available and an equal number in reserve at other mines in California and Nevada who had volunteered their services in case of need. It was decided not to call upon the reserve at the distant mines unless their services were actually required in the rescue of live men.

The fresh-air crews consisted of picked Kennedy and Argonaut miners who had worked in the 3600 and the 3900 level connection drifts and who were anxious to give every assistance in the rescue of their entombed comrades.

The final break through of the Kennedy 3600 raise into the Argonaut 4200 workings was expected all day Sunday, Sept. 17, and until midnight of that day the mine rescue crews were held in readiness at the rescue station in anticipation of the event. At midnight word came from below that the break through could not possibly be made until 4 a.m. Monday morning, Sept. 18, and the rescue crews were ordered to bed. All were called at 4 a.m., as the break through had been made and volumes of air were rushing through the connection raise into the Argonaut mine. However, it was not until eleven in the morning that the break through connection was made large enough to permit of a man's passing with oxygen breathing apparatus. The apparatus men experienced considerable difficulty in carrying their apparatus from the Kennedy 3600 station to the Argonaut workings, as the drift that the miners had opened was very small in cross-section in many places, in fact, there were distances of several hundred feet where the drift was not over 3 ft. high. The connection raise which was driven was also restricted in cross-section and it was only with extreme difficulty that men wearing apparatus could pass through it.

### Rescue and Recovery Work

At 11:30 a.m., groups A and B of the apparatus men, accompanied by Pickard, Woodburn, D. Harrington, and Kindall, were lowered to the Kennedy 3600 station. They proceeded immediately to establish a fresh-air base; one crew was sent up through the connection raise to explore a portion of the Argonaut 4200 level. This crew discovered that most of the 4200 Argonaut level was comparatively good air, as the suction fan from the Muldoon shaft was pulling fresh air through the workings from the Kennedy shaft and exhausting into the Muldoon. It was deemed advisable to make immediate exploration of the 4200 station to ascertain whether the shaft had been burned at this depth. This exploration, therefore, was made and everyone was greatly relieved when they found the station to be intact.

The doors in the cross-cut leading to the 4200 station prevented fresh air from going to the 4200 station, consequently the atmosphere at the Argonaut station was noxious. The doors were opened and as soon as possible the fresh-air crews were constructing a door in the drift to the Muldoon shaft to force air into the 4200 station of the Argonaut, where a fresh-air base was established almost immediately. Future rescue operations were carried on with the 4200 station of the Argonaut as the fresh-air base.

Meanwhile, another apparatus crew thoroughly explored all of the 4200-level workings to ascertain whether any of the entombed men were on this level. This exploration was without result except in determining that all dead ends contained noxious gases. It was decided, therefore, to make exploration of the 4350 level. Before this could be done, it was necessary to construct a bulkhead immediately above the 4200 station. This was done for two purposes: (*a*) To

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protect men going down the shaft from timber, rocks, etc., which might fall from the fire zone. The lower limits of the fire zone could not be determined at this time, but it was felt that there was great danger from falling debris from the blocked fire zone; (*b*) To force fresh air down the Argonaut shaft to the 4350 level.

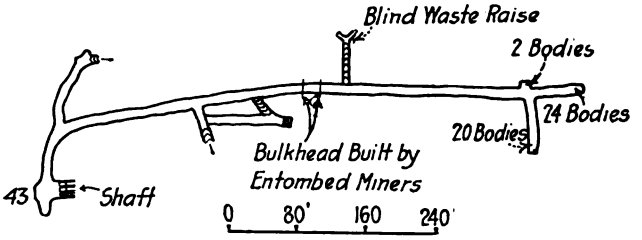
Apparatus crew No. 1, group A, was instructed to descend carefully on the ladders and immediately upon arrival at the 4350 station to open the door to permit sweeping out of the gases and short-circuiting to the Muldoon. Upon arrival at the 4350 level at 4 p.m., the crew signalled (by pre-arranged code of hammering on the compressed-air pipe), and the door was opened. At 4:20 p.m., crew two of group A were called for and immediately descended the ladders to the 4350 level. Team one reported that there was fresh air on the 4350 station and in the Muldoon exit and everything was explored except a long cross-cut into the foot walls.

This cross-cut was explored at 4:40 p.m. and the captain of the apparatus team reported that 50 ft. in from the waste raise they discovered a bulkhead which evidently had been built by entombed miners. It was constructed of miscellaneous timbers, clothing and waste rock. In the vicinity of the bulkhead, the canary bird dropped from its perch and the carbide lamps were extinguished. The crew knocked on the bulkhead, but received no answer. They returned to the station and asked for orders on opening the bulkhead. Orders were given not to open the bulkhead until fresh air could be brought to its face.

First aid and resuscitation supplies were immediately ordered by Doctor Kindall, who had descended in the meanwhile to the 4350 station. The fresh-air men were ordered to bring in a compressed-air line to the 4200 station where it was carried into the 4350 station by the apparatus men. Also, telephones were installed to connect from the 4350 and the 4200 levels to the main Kennedy line at the 3600 level. Messages to the surface were relayed from the Kennedy station by separate telephone.

There was some delay in getting the compressed-air line to work, as it was hastily constructed and plugged at some point. It was decided not to wait longer for the air line, and the first bulkhead was broken. A second bulkhead 25 ft. from the first bulkhead was discovered. The air between the two bulkheads was very foul and would not support the flame of the carbide light and the canary was also visibly affected.

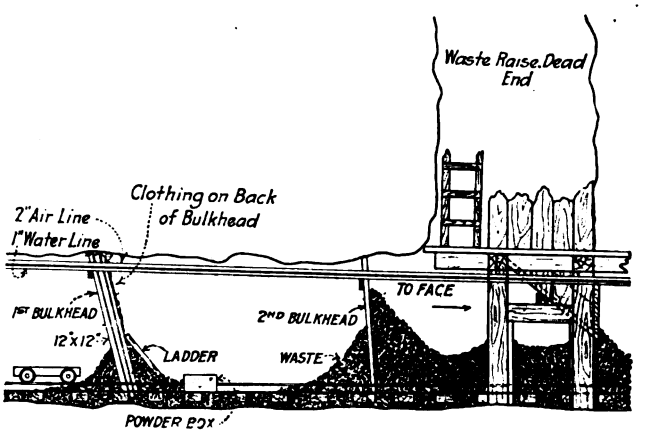
The second bulkhead was constructed in a way similar to the first except that it was not complete, the miners evidently having run out of material. In the upper right hand corner was a large hole; piled against the boards was a considerable amount of waste rock drawn from a chute from a dead end raise inside of the second bulkhead. A powder box evidently had been used in carrying the waste rock from the chute. It was known immediately after the second bulkhead was discovered that there was no possibility of men being alive behind it, as the canary bird fell off its perch and the carbide light was extinguished; also, the distinctive odor from dead bodies was very strong. Later, at the face of the cross-cut where the bodies




PLAN OF ARGONAUT 4300-FT. LEVEL.

were found, a vacuum tube air sample was taken, analysis of which gave 0.21 per cent. CO; 5.71 per cent. $CO_2$; 14.18 per cent. O.

Crew two of group A broke down this second bulkhead and made exploration to the face of the cross-cut. They reported this exploration at 5:16 p.m. and stated that many dead bodies had been found and that it was




LONGITUDINAL SECTION OF BULKHEADS.

more than likely that all of the entombed men were in the cross-cut. At 6:45 p.m. an attempt to count the dead bodies was made but one rescuer's oxygen gave out and the count was not completed. The count varied between 42 and 45 bodies.

Meanwhile, the rescue crews were endeavoring to get the fresh-air line completed and arrangements to recover the bodies were considered. To get the bodies to the surface it was necessary to bring them from their tomb to the 4350 station, hoist them to the 4200 station, carry them to the Kennedy connection raise, where they would have to be lowered to the Kennedy 3600 level and carried to the 3600 station from which they could be hoisted in the main Kennedy skip to the surface.

To do this, special arrangements had to be made to hoist the bodies from the 4350 to the 4200 level. A rudely constructed board skip running on greased rails was ordered and a tugger hoist installed at the 4200 station. This work was done by the fresh-air crews.

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Supplies such as stretchers, canvas, rubber gloves, disinfecting materials, etc., were being brought in by the fresh-air crews.

Altogether, six apparatus crews were used in the exploration of the 4200 and the 4350 levels, discovering the bulkheads, counting the bodies and in restoring ventilation so that the bodies could be recovered.

The bodies were reported to be badly decomposed and the first plans of having them wrapped in place and left for fresh-air men to carry out had to be changed. It was determined that as soon as a body was wrapped it should be placed in a Stokes Navy stretcher and carried by apparatus men to the 4350 station and hoisted to the 4200 station, where it was turned over to the fresh-air men to be relayed to the 3600 station of the Kennedy. From six to eight relay fresh-air crews were utilized in getting the bodies to the 3600 station. In the recovery of the first few bodies, from an hour to two hours were required to wrap the body and get it to the 3600 station. This time was later cut to 30 minutes.

A complete count of the bodies was ordered and a count by three different men showed 47 bodies in the cross-cut; 46 bodies were recovered and on the surface by 9:41 p.m., Sept. 20. It was reported about 8 p.m. by the apparatus men that there was one body missing. Evidently an error had been made by the three men who did the preliminary counting. This error can be explained by the fact that there were several piles of bodies and a correct count could only have been made by pulling them apart and distributing them in the drift—which, of course, could not be done owing to the great extent of the decomposition.

Judging from the positions in which the bodies were found and the conditions of the bulkheads, it is the general opinion that the men were being affected by poisonous gases before they completed the second bulkhead and they retreated to the far ends of the cross-cut. It will be noted on the accompanying sketch that two bodies were found in one stub end, 24 in the breast of the main cross-cut and 20 in a longer stub drift. Several of the bodies were found in a reclining position with their heads resting on their arms or with a pillow made of underclothing; others had fallen forward on their faces; some had fallen on their sides; most of them were so closely bunched together that when they died they fell over on one another.

As has been described in the daily press, the only message that was found with the men was written with the smoke flame of a carbide lamp on the slate face of the main cross-cut. This message read "3 oclock. Gas getting strong. 4 o/cl. Fessel $3^{20}$".

It is quite evident that the entombed men did not live long behind their bulkheads; opinions vary from 4 or 5 hr. to 16 or 17 hr. Search for the forty-seventh man was prosecuted with diligence, and all the accessible workings from the 3700 level of the Argonaut to and below the 4500 level were explored by apparatus men without result.

The apparatus men found on the 4500 level that the door to the ventilation raise had been left open but that no air was circulating on account of a rush of water down a waste chute which had filled up the cross-cut to the ventilation raise. The atmosphere of the 4500 level would not support combustion and the canary bird was almost immediately affected, several days after ventilation had been restored on the 4350 level. The 3900 level and station of the Argonaut had not been affected by the fire.

Upon further investigation, it was determined that the blocked area in the shaft, due to the cave-in from the fire, was in the immediate vicinity of the 3700 station; that is, the fire area extended from 12 sets below the 2550 level to the vicinity of the 3750 level. The water level on Sept. 27 was not definitely determined but was known to be between the 4500 and the 4650 levels.

It is doubtful if the origin of the fire will ever be known.

### Special Aids in Fire Fighting

*Work of the Red Cross.*—Everyone participating in the rescue work at the Argonaut appreciates the wonderful assistance given by the Red Cross. It was through their efforts and cheerfulness that the morale of the rescue workers was kept up.

*The management* of the Argonaut mine, after realizing the utter hopelessness of controlling the fire in the Argonaut shaft, did everything possible to rescue the entombed miners; in fact, the mine and operations were completely turned over to the executive and advisory committees and no expense was spared to expedite any proposed undertaking.

*Self-contained oxygen breathing apparatus* played an important part in the attempted rescue and the recovery operations. Sixty-five different men wore apparatus during the three weeks; a total of 1600 man-hours was spent in apparatus work, about 400 hours of which were under oxygen.

This work was done without injury to any apparatus wearer, and without any crew having to turn back on account of defective apparatus.

*Airplanes*, furnished by the U. S. Army at the Presidio in San Francisco, were used to great advantage in the rescue operations through expediting transportation of men and supplies from San Francisco to Jackson.

## Fumes Encountered in Mining Operations and Handling Explosives

FUMES encountered in mining operations, particularly with respect to explosives, form the subject of an interesting and comprehensive paper prepared by J. Barab, of the Hercules Powder Co. Copies of this may be obtained from the Hercules Powder Co., Wilmington, Del. The report consists of 41 typewritten pages and contains a short bibliography in addition.

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# Engineers Work in Russia Through the Relief Administration*

By EDGAR RICKARD

Director General, American Relief Administration

IT SHOULD be clearly understood that my remarks on economic conditions in Russia are entirely personal, and not official as an officer of the American Relief Administration. The American Relief Administration is concerned exclusively in relief operations.

The American Relief Administration has played a large part in the conditions as they exist in Russia today and it does not seem to be out of order to give you the high lights of the work accomplished.

## Sixty Million Dollars for Russian Relief

The Riga Agreement, by which we were enabled to carry on our operations, was signed in Riga on Aug. 20 of last year. On Sept. 8, we opened our first relief station in Petrograd. On Sept. 18, our first food was handed out in Samara on the Volga River, in the center of the so-called famine district. Altogether over 775,000 tons of food have been sent from the Atlantic Coast into Russia and we have moved this entire quantity of food over a dilapidated and wornout system of railways; and we estimate that our loss will be less than one-half of one per cent. in shortages and thefts. We have had available for this Russian work approximately $60,000,000. The bulk of this money was derived from a Congressional grant of $20,000,000 for food stuffs, a further Congressional grant of Army medical surplus supplies of $4,000,000, a grant by the Soviet Government of $11,400,000. This Soviet grant is a rather interesting phase of our operations. In all of Mr. Hoover's relief work abroad he has demanded of the country receiving relief that the people themselves do something concrete for their own good before he would undertake to collect large sums of money in America. Secondly, before he was willing to go before Congress and ask for funds from our government he desired that the Soviet Government show their good will.

We asked them to give us all the gold that they could possibly accumulate and they gave us 20,000,000 gold rubles in Petrograd, which was brought out under our own auspices through the Scandinavian countries and transmitted by steamer to New York, melted and converted into gold for our own purchases. In addition to this, we have had a fund from the American Red Cross for purchasing medical supplies and equipment amounting to $3,600,000. The Jewish Joint Distribution Committee has given us sums which will total about $5,000,000.

I have accounted for nearly all of the $60,000,000, but we have also during this period carried on more or less of a commercial enterprise. In our own office, this commercial enterprise is called the Food Remittance Department. The food remittance is a scheme by which we sell for dollars in New York an order on our warehouses in Russia. We sell these remittances in units of $10. We have a definite statement on the receipts that we give, whereby we retain $2.50 of the food which is carried into Russia, for the purpose of giving it to the children there. This food remittance operation, up to this week, has brought in $8,700,000 from 440,000 remittances in the United States and Europe as well. We have sold these remittances in Paris, London, Warsaw and Budapest. We make no secret of the fact that we make a profit out of this operation. The profit to date is probably nearly $2,000,000. Whichever way you want to figure this profit, whether it goes into additional food for the children in Russia or whether it is considered from a purely accounting standpoint as a profit, it certainly will more than pay the expenses of the entire administration, not only for the period that has just passed but for the period we are entering, so that every dollar we have received has been delivered 100 per cent. in Russia.

## More than Ten Million People Fed

We reached the peak of our operations last August, when we were feeding 10,400,000 people in Russia; of this number, probably 4,200,000 were children. This was accomplished in 28,000 kitchens in over 18,000 cities, towns and villages. We employed over 120,000 Russians, who were supervised by almost an even 200 Americans. One of the most spectacular operations we have undertaken was the attempt to carry on medical relief on a mass basis. We have supplied 2481 hospitals with a capacity of over 200,000 beds with complete equipment from top to bottom and through this period have fed over 50,000 adults in these institutions. This medical work is of a very

* Address delivered at New York Section Meeting, A. I. M. E., Oct. 4, 1922.

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far-reaching and permanent character. When I was in Russia in the town of Samara, I found there a great Pasteur Institute that was celebrated throughout the whole of Europe. This Institute had ceased to function, as the employees were obliged to go out on the streets in order to obtain sufficient food for their needs. With a very small expenditure of food for this staff and a few phials from our Army surplus stocks, this Institute was enabled to produce 300 liters of serum per month, sufficient to inoculate 300,000 people. This is only one of the many things we have done with this medical operation.

The harvest reduced the 4,200,000 needy children to 800,000 and we stopped feeding all of the adults at that time. We will increase the feeding of children as the effect of the harvest wanes; we have a program providing for feeding a minimum of 1,300,000 children and expect to be called upon to feed 1,000,000 adults, beginning with the first of the year. We also intend to keep up the food remittance business, and we do not mind telling you that we are doing it not only because it is a great relief measure but because it has become a source of transmitting dollars into rubles. We know that a great many people who receive our food packages in Russia can dispose of them for from 50 to 60 per cent. more in gold value in Russia than they cost here. In other words, the sender spends $10 on a remittance which the recipient can sell for from $14 to $25 on the other side, and thus obtains money for other than food necessities.

### Far-reaching Results of American Relief Work

The Russians are so appreciative that it is very embarrassing for one of Mr. Hoover's agents to go into any part of Europe and Russia, particularly at the present time.

We are asked very often whether we have been handicapped in Russia by the suspicion that the American Relief Administration was there for some purpose other than pure relief. When we first went in they discovered all sorts of excuses everywhere for our apparent domination of the position in Russia. I brought out a little sheet of paper as an example. We sent one of our men, whose name was Kinne—an Irishman—to one of our most distant points, a place called Ufa, with the usual equipment of a stenographer, a typewriting machine and an enormous number of printed report blanks, and with definite instructions that he must give us these reports in six copies. He found that the work was so great that he had to send his stenographer out as a child feeder, which left him alone to compile his reports. He decided to practice on the typewriter, and in a little book of instructions he found some sentences, which he ran off on sheets of paper. One of them read, "Now is the time for all good men to come to the aid of their party." Another was, "If you move your guns ten yards to the right you will cover two of the enemy's ships." After his practicing he threw these sheets into the waste basket. The next morning he was arrested and brought before the tribunal with these papers as evidences of his desire to create a counter-revolution. If it were not for some of these humorous experiences, our men would completely collapse. I can assure you that there is no better example in this world of fine spirit than is shown by the men we have over there.

Diverting from actual relief work, we are often confronted with statements that the American relief operations in Russia are supporting the Communistic party and continuing it indefinitely. Now, this is a complete fallacy. When we went in the Soviet party had been in power four years. No one had been in there before. There were a great number of Americans imprisoned in Russia who were not able to communicate with the outside world. In fact, it was an isolated country with which there was no communication. The American Relief Administration served to open up that country to the world and our Riga Agreement, among other things, released every one of those American prisoners. That was one of the definite conditions of the Riga Agreement, and, in fact, its fulfillment delayed us about four days in our actual operations. We would not send in the first lot of food until all the prisoners were out and safe. As a result of the Riga Agreement, Russia was opened to correspondents of every country in the world.

Since we have been in Russia we have not known of any absolute and outright murders that have taken place by the government. We do not think that they have occurred. They have given trials—some of them have been cursory, but at least they have gone through the form—and in the case of bandits, we believe they have given justice. At any rate, there have been none of the summary executions that took place before, and we believe we have had something to do with that.

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In speaking of the general Russian situation as the background of the stupendous and varied operations of the American Relief Administration, Mr. Rickard pointed out that there are no less than 27 autonomous states within the present boundaries of Soviet Russia. The existence of these states within the Soviet federation presents a considerable problem to the Central Government, since the interests of all these states are by no means the same nor do they always coincide with the interests of the federation as a whole. The disposition of this year's crops is a case in point. In the Soviet Republic of the Ukraine, for example, there is, according to official estimates, which are doubtless correct, a surplus of 50,000,000 poods of grain which is worth about $80,000,000. If the Ukraine were free to act independently, this grain might be sold abroad to considerable profit for the Ukrainian Government. Obviously strong persuasion from Moscow is required

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to convince the Ukrainians that such an export would be contrary to the interests of Russia as a whole.

These sectional differences originating in the 27 autonomous states disappear when the question of the defence of Russia arises. Although there may be differences of opinion with regard to internal policies, the great majority of these peoples regard themselves first as Russians and as such are intensely patriotic. Within the Central Government itself there are undoubtedly also many conflicts and differences of opinion between the various departments, but when a national policy is announced the Government invariably presents a united front. This unity is particularly striking in times of national danger, such as during the wars against Denikin and Wrangel in the South and against Poland in the West.

With regard to the question of the investment of foreign capital in Russia which is continually discussed, Mr. Rickard expressed a doubt whether the Soviet Government would grant concessions of any great magnitude to foreign capitalists. Such concessions, it was pointed out, in view of the tremendous risks would have to yield an enormous profit, considerably beyond the demands of commerce, before foreign business men would be willing to invest money in Russia. Such a contract on the basis of great possible profits would immediately be attacked by the extreme Communists as an betrayal of Russia—as a surrender of the country and its people to the exploitation of foreign bourgeoisie. The freedom and defense of the proletariat from such exploitation is still the war-cry of the thorough-going Communists, who, in spite of the tendency of the government to abandon their extreme theories and in spite of the changes which have taken place in Russia in the last year, still hold an important position and exercise a powerful influence on Governmental policies.

In the systems of rail and river transportation the Soviet Government has inherited a splendid machinery of commerce created under the Czar's régime. Though these systems have naturally greatly deteriorated, they function surprisingly well. In traveling many thousand miles in Russia Mr. Rickard found that trains ran on schedule. Only once was his train late, due to a delay caused by a wreck on the main line, which necessitated sending his train over a circuitous route. In spite of this added distance the train made up four hours of the time lost and arrived in Moscow only two hours late. The line from Moscow to Minsk, about 425 miles, shows evidence of having had attention paid to it, the right of way being as clean as it possibly could be and the sleeping cars newly painted and renovated and, Russia, unusually clean. There are, however, relatively only a few trains operating where there ought to be several hundred, and the freight movement is limited chiefly to the American relief supplies. Railroad fares in roubles are staggering. From Moscow to Petrograd, a distance of 610 versts, the fare is 48,000,000 roubles.

One of the most striking things seen by Mr. Rickard in Russia was the operation of the boats on the Volga River. None of our Mississippi River boats can compare with three or four of the largest steamers, which are comparatively new, now operating on the Volga. Most of these steamers are named for famous revolutionists or for places and institutions associated with the Revolution. One, a beautiful boat, with a speed of 17 or 18 knots, was called the "Third Internationale," another was called the "Lenin" and another "The Red Soldier." Traveling on the Volga one sees an almost continuous procession of huge oil barges on their way from Baku to the various oil stations along the route. All of the railways east of Moscow are equipped with oil-burning locomotives, and all river boats use oil for fuel. Despite the almost complete neglect of the country for political experiment by those who are in authority in Moscow, the people themselves have made the railways work and have made these boats run. Considering Russia's isolation, its demoralization, and the conditions under which its people live, this is a remarkable achievement. Every city visited had an electric plant functioning, furnishing current for its electric lights and power for its electric railways. There is no building in these cities and but little repairing, but the local officials have succeeded in keeping the streets reasonably clean—this being partly the result of the general "clean up" campaign put through by the medical department of the A.R.A. In most towns, many shops have opened, thanks to the Government's new economic policy and there is a general indication of a renewal of commercial activity—as yet somewhat superficial but in striking contrast to conditions when the American Relief Administration entered Russia.

In conclusion, Mr. Rickard said: "I have no sympathy at all with the Communistic principles which are dominating Russia today, but my own opinion is that Russia stands a better change of becoming one of the great nations of the world by building up from the wreck caused by breaking down the impossible autocracy which existed prior to the war than it ever had under the régime of the Czar."

## Conditions in Russia for American Investments*

By Boris Bakhmeteff†

THE work of the American Relief Administration in Russia has been the greatest constructive humanitarian contribution that has ever been given by any people and it is the greatest moral investment that any country could make in Russia.

Russia is very patriotic with a new kind of patriotism.

* Formerly Ambassador from Russia under the Kerensky Government.

† Address delivered at New York Section Meeting, A. I. M. E., Oct. 4, 1922.

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It is very vibrant, very young, very raw. For three or four years after the Bolsheviki came into power, Russia was dead and the Communist Party which seized the power was so absolutely overpowering and oppressive that many patriotic hearts really doubted whether Russia was going to come back, whether Russia would follow the example of many other civilizations and just be buried in the ashes of revolutions. There was only one thing that could save the country, and that was the very fundamental quality, the voice of the people as such.

Russia by this revolution has really been brought down to the elemental things. The shaking up of the country has been so great that any effort to build up the country by centralized governmental effort is absolutely futile. They try to run everything and do not want to give any freedom of choice or any freedom of initiative or activity to an individual.

In the past, although we have always had the reputation of being a nation soft and idealistic and impractical, we have been a nation of warriors battling against every pressure from east and west. Starting as a small tribe up on the Neva River, surrounded by big states, simply through the character of the people, through that genius of Nordic stock which we have together with the Anglo Saxon, we have extended by pioneer effort. The story of our colonization of Siberia and of the East, and of our pushing down to the Black Sea, is the same story as that of your conquering the West. Unfortunately, the czarist system of government which came in was not fitted to the Russian people who are essentially a nation with a genius for self-government. Our whole story of the 9th, 10th, 11th and 12th centuries is a story of Russian self-government and republics and commonwealths.

What has happened in the last eighteen months? Life is coming back everywhere. Intellectually and psychologically, the revolution in Russia is over. In the minds of the people, the idea of destruction and the political sleepiness have passed. They are forming a new consciousness and it is the post-revolutionary consciousness which is going to save Russia. There are two complete reactions from the Communistic government. The first is the idea of property. The Communistic system was built on the negation of private property, or the nationalization of property. They made the most thorough and complete attempt to apply the principles of Socialism. Russia intellectually is now the least Socialistic country in the world. Socialism has gone down and the necessity of individual property is pressing upon the mentality of the people. With the peasants it has come back completely. Recently, in South Russia, there was a congress of miners to deliberate about conditions which were absolutely unbearable. People were starving, there was no production, there was no work, and the chairman of that meeting, a workman who had come up through the revolution and stands at the head of this Bolshevik trade union, a die-hard Communist, quite earnestly started his speech by saying, "Fellows, we must confess and we must say frankly and straightly there is absolutely no way of restoring the production in this coal mine and in this coal region except by restoring these coal mines to their old proprietors, I mean establishing private property in these mines." That shows the change of psychology in Russia and it is going to prevail.

The second reaction is the growing sense of self-dependence. Until lately the Russian peasant has been accustomed to be ruled, to be told what to do, to seek leadership and advice from outside. During the last four or five years the government tried to take something from him and gave him nothing. Because of that the peasant got extremely selfish and extremely distrustful of any central authority, but he has got extremely independent and has the idea that nothing can save him but to stand on his own feet; that he has to provide for the protection of his own interests. In most peasant communities the peasants have organized themselves not in a dramatic revolutionary way, but by peaceful resistance and have established practically peasant self-ruling communities.

The Bolsheviki in Moscow have been changing their ideas. If they could afford to they would continue Socialist; if they could afford to they would continue to make a real revolution. They cannot afford to. They cannot afford to because life has been stronger than they are and the preposterous ideas by which they have ruined Russia are being set aside by the growth of the peasant.

You cannot break the passive resistance of 125 million peasants, and that is the thing which has been compelling Lenine and the others to make concessions, which they have done insincerely, which accounts for the fact that there is still no production and that the production can resume only when the individualistic process of production and private property are restored. That process is now going on and the Communistic power is shrinking in spirit and shrinking also in authority.

This growth from below is pushing out Communism, and against it Communism is battling in a desperate battle which is not measured by years but is measured probably by months. I believe the conditions are not ripe yet for American business enterprise and it would be unfair for me to suggest to any American friend or to any American who asked my advice to go in there at once. I do not believe the conditions are ripe; I do not think the evolution has reached a stage where it is advisable.

The time is coming when we all have to be on the lookout. We are on the eve of great changes, we are on the eve of a period of reconstruction which is due to the mental and psychological transformation through which the people have passed and to the fact that the revolution is practically ended. The government is still holding on with a set of preposterous conditions, but we may wake any day and find that sensational changes have taken place which will start a new era.

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# Geology, Mining and Metallurgy of the New Comstock

## Résumé of Geology of United Comstock Mines*

By Wilbur H. Grant†

THE property of the United Comstock Mines Co. lies in the eastern foot-hills of the Sierra Nevada Mountains, in the Washoe mining district of Storey County, Nev. Commencing at the boundary line between Virginia City and Gold Hill, covering all the town of Gold Hill, it extends south to American Flat; the main camp, or the new town of Comstock, the mills, shops, residences of employees, and the main haulage-tunnel portal are located on American Flat.

The property extends for about 10,300 ft. along the lode; this covers the southern end of the main Comstock lode, the Knickerbocker branch, and the junction of the Silver City branch with the Comstock lode. Within the property, 5000 ft. of the main Comstock lode is known to have been productive, 1000 ft. of the lode at the northern end of the property is thoroughly developed, and 1000 ft. south of this is partly developed; this leaves about 3000 ft. of the known productive portion that has not been opened up by this company.

The northern end of the property, or the Imperial mine, has been intricately developed by five main levels and numerous sublevels. The Yellow Jacket ground to the south has been partly developed by the reopening of three old levels.

In addition, the main haulage level is driven from the portal at Comstock for 9250 ft., to the north end of the property; about 5500 ft. of this is in the foot wall of the lode and parallel to it.

### General Geology

Government geologists and engineers have determined at least 14 rocks composing the country of the Washoe district. Of these, three are sedimentary, one is metamorphic igneous, five are essentially effusive or surface flow rocks, and five are intrusive; two of the intrusives are granitic and three are porphyritic. All of these are in a complicated relationship to one another; their exact relation is difficult to determine on account of the intense alteration by mineralizing solutions and surface leaching in the vicinity of the lodes. If a detailed study of the andesites, which have been differentiated by previous geologists, could be made, it is possible that several of them might prove to be only phases of the same andesite.

This rock complex was fractured in a general north-south direction along three fairly well defined zones and these fractured zones subsequently were intruded by mineralizing solutions. There is also a branch to Silver City, southeast of the Belcher mine, which is called the Silver City branch of the Comstock lode. Another extends southwesterly from the Belcher and is called the Knickerbocker branch. The junction of these two is taken, roughly, to be the southern end of the main Comstock lode. The first fracture system east of the Comstock lode is called the Occidental or Brunswick lode, the next farther east, the Flowery lode. By far the greatest production has come from the main Comstock lode, less has come from the Silver City branch, still less from the Occidental lode, less still from the Flowery lode, and least of all from the Knickerbocker branch.

The fissure zones in which the lodes form do not strike north-south in a straight line, but are composed prevailingly of two components. The average strike of one of these is N 45° E and one N 30° W. These components cause the lode to form in a twisted course, which has a resultant direction of magnetic north, or about N 14° E (astronomic), as exposed on surface.

As shown by development with depth, the main Comstock lode tended to form along a true fault fissure with a northerly strike and an average dip of 43° to the east. Branching up vertically from this prevailing portion of the lode, there were fractures into which ascending solutions penetrated and deposited some of the bonanza orebodies; the great Consolidated Virginia bonanza was of this type. The outcrop of the Comstock lode is a variable mineralization and replacement of the shattered rock in the wedge between the normal fissure and one of these vertical branches.

The ore in the Imperial mine has been developed above the main haulage level in the wedge between the 43° easterly dipping Comstock lode and a vertical branch. Instead of being perfectly vertical, it develops a crescent shape and forms a sharp east wall to the ore. At the surface, this east wall dips westerly; at a depth of about 300 ft. it is vertical; below this it gradually bends into the normal 43° dip to the east. A pronounced fault gouge, 10 ft. or more thick, follows this east wall of the ore. In the lower levels this gouge is

* Presented at the San Francisco Meeting, September, 1922.

† Geologist, Metals Exploration Co., Gold Hill, Nev.

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dry and hard, while near the surface it is wet and soft. The value of the orebody decreases toward the west wall until it becomes an uncommercial product, so there is no sharp limit to the ore in that direction. This is an important feature in mining, as any dilution of the ore by the caving in of the west wall will not reduce the grade of the general average perceptibly, as the west wall carries ore of some value. The wedge continues to be mineralized back westerly to the main 43° easterly dipping foot wall. In this portion some strong quartz of fair value has been found.

Only one rock has been found in the Imperial ground. This is an andesite highly altered by the mineralizing solutions and surface leaching. On the whole, the mineralization is so intense that the original character of the andesite cannot be determined, but occasionally it is recognizable. Surface leaching appears to bring out the original character of the andesite, where it has been thoroughly silicified. Some of the crosscuts back into the foot wall show partly mineralized extrusive andesite breccia and some andesite tuff.

The gangue minerals are essentially quartz and calcite, the former prevailing. This mineralization varies from solid white quartz to stockwork veinlets, to silicified andesite, to recognizable andesite altered by mineralizing solutions and leaching. All these types grade into one another but they are sufficiently distinct to enable a geologist to map four classes of mineralization. These classifications are stope fills, rock in place more than half quartz, silicified andesite, and recognizable andesite somewhat silicified. There is no fresh andesite in the Imperial workings, but it is found farther from the mineralized zone. Associated with the primary gangue minerals are oxidized minerals, such as sulfates, consisting—in the order of their abundance—of epsomite, gypsum, melanterite and lesser amounts of sulfates of magnanese, aluminum, and copper, also kaolin and oxides of iron and manganese. On account of the low-grade character of the ore, metallic minerals are not easily recognizable.

Pyrite is the most common with some argentite, haloids, and metallic silver. Most of the secondary metallic minerals are within 500 ft. of the surface, but even here they are intermixed with remnants of the primary sulfides.

### Main Haulage Tunnel

From the portal to a point where it crosses the Knickerbocker branch of the Comstock lode, the main haulage tunnel is entirely within andesite, which is fairly fresh and gray to purplish brown in color. In crossing the lode, the tunnel exposed only weak mineralization in soft, wet ground. A strong flow of warm water was encountered, which has continued uninterruptedly to date. This warm mine water is a valuable asset for milling, especially during the winter.

Farther along, after making the turn to a drift parallel to the lode in the foot wall, the tunnel pierced a complex of andesite intrusive into limestone and shale. The limestone was somewhat metamorphosed and silicified. This tunnel, therefore, will not only afford an exit for the ore, but furnishes warm water for mill operations and it is possible that ultimately there will be found sufficient limestone containing enough soluble lime when calcined to be satisfactory for mill use.

### Gold and Silver Ore

Becker[1] has compiled the production of the principal Comstock mines up to June 30, 1880, including most of the mines now owned by the United Comstock Mines Co. The valuable metals produced are practically all gold and silver. He has figured the value of gold at $20.67 and silver at $1.2929.

Claims of Consolidated Imperial Group

| | Tons (2,000 lb.) | Average Value | Production |
|---|---|---|---|
| Imperial | 223,047 | $23.42 | $ 5,224,672.75 |
| Bacon | 22,846 | 24.99 | 570,931.25 |
| Empire | 162,164 | 21.05 | 3,414,594.12 |
| Eclipse | 3,174 | 25.65 | 81,431.04 |
| Trench | | | |
| Empire South | | | |
| Plato | 797 | 19.71 | 15,728.47 |
| Bowers | 4,795 | 17.36 | 83,245.95 |
| Piute | | | |
| J. Winters | | | |
| Consolidated | 11,831 | 42.65 | 504,561.49 |
| Consolidated Imperial | 37,787 | 15.42 | 583,012.49 |
| Challenge | 1,943 | 22.56 | 43,839.05 |
| Confidence | 10,470 | 20.74 | 217,217.28 |
| Burke and Hamilton | 1,008 | 28.22 | 28,465.99 |
| Totals and average | 479,862 | $22.44 | $10,767,699.88 |
| **Yellow Jacket Group** | | | |
| Yellow Jacket | 443,747 | $29.29 | $12,998,170.82 |
| Kentuck | 142,289 | 34.47 | 4,905,271.01 |
| Crown Point | 815,605 | 36.84 | 30,049,673.50 |
| Belcher | 702,236 | 46.52 | 32,672,166.29 |
| | 2,103,877 | $38.32 | $80,625,281.62 |
| Segregated Belcher | 4,961 | $20.44 | $ 101,466.81 |
| **Overman Group** | | | |
| Trojan | 12,810 | $11.27 | $ 144,392.81 |
| Overman | 77,623 | 18.18 | 1,411,489.06 |
| Total and average | 90,433 | $17.20 | $ 1,555,881.87 |
| Grand total and average | 2,679,133 | $34.73 | $93,050,330.18 |

This shows a total recorded bullion production of over $93,000,000 up to that date. If there are added to this amount the production since 1880, which is relatively small, and the estimated unrecorded production, and this sum is converted to the gross value rather than bullion value, there will undoubtedly have been more than $100,000,000 produced from the ground now owned by this company. The proportion of the gold and silver in the mines owned by this company is as follows:

[1] U. S. Geol. Survey *Monograph* III.

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| | U. C. M. Co. | | Becker | |
|---|---|---|---|---|
| | Gold Per Cent | Silver Per Cent | Gold Per Cent | Silver Per Cent |
| Consolidated Imperial | 28.1 | 71.9 | 42.9 | 57.1 |
| Yellow Jacket | 31.0 | 69.0 | 31.9 | 68.1 |
| Crown Point | 31.5 | 68.5 | 42.5 | 57.5 |
| Belcher | 57.0 | 43.0 | 56.7 | 43.3 |
| Lambert Tunnel | 51.0 | 49.0 | | |

The average grade of ore produced from these mines is:

| | |
|---|---|
| Imperial Group | $22.44 |
| Yellow Jacket | 29.29 |
| Kentuck | 34.47 |
| Crown Point | 36.84 |
| Belcher | 46.52 |
| Segregated Belcher | 20.44 |
| Overman | 17.20 |
| Average | $34.73 |

These two last tables show that the grade of ore and the gold content increase southerly from the Imperial mine; they reach their highest value at the Belcher mine and then decrease as far as ore has been mined southerly. Statistics show that the highest proportion of silver in any oreshoot was usually found near the surface, the proportion of gold to silver increasing with depth. This need not, however, modify the above deduction, as both surface and deep ore are included in the production from each mine. For convenience of operation and to take advantage of the metal market, the work of development and mining will progress from the Imperial ground southerly.

It has been found that the best grade of ore is in the old fills and much of the walls of the old stopes can now be mined at a profit. It is anticipated, therefore, that practically all of the ore to be mined above the main haulage level will be in the vicinity of the old stopes and that there will be barren stretches along the lode between these low-grade bodies. It is inconceivable that all bonanza pockets have been discovered and mined. Small pockets of such good ore will be taken out with the other ore by the method of mining that has been selected.

### Future Possibilities

A geological study of the property indicates that three-fifths of the length of the lode within the property, which has been productive in the past, still remains to be developed above the main haulage levels, with small possibilities on the branch veins above this horizon. About 1000 ft., vertically, between the main haulage level and the Sutro tunnel, there is ground which contains exposed bonanza orebodies that were abandoned on account of mine fires and never recovered; also, there are possibilities of developing other small bonanza bodies and large bodies of fills and low-grade vein material in place, such as have been developed in the Imperial workings above the main haulage tunnel.

There are indefinite possibilities below the Sutro tunnel level. Edson S. Bastin,[2] after a detailed, microscopic study of the ores says that, "Although the occurrence in the deep portions of the lode of orebodies comparable in size and richness to the great bonanzas of the past is not to be expected, yet the primary origin of some of the rich ores offers encouragement for deep development."

Many phases of the geology of the United Comstock Mines might be elaborated upon and afford considerable interest to scientists, and other features would be of great interest to mining investors, but on account of the limited length of this paper, an endeavor has been made to balance the essential features of each.

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## Proposed Mining Methods of United Comstock Mines Company *

By John R. Reigart †

THE property of the United Comstock Mines Co., at Gold Hill, Storey County, Nev., consists of the so-called Gold Hill group of mines on the Comstock Lode. It embraces the portion of the lode from the old Alpha mine, at the north end of Gold Hill, southerly through the Globe group of claims, northwest of American Flat. Development work has been confined almost exclusively to the extreme northern portion of this area—the Yellow Jacket and Imperial groups—and this paper will deal with the mining methods planned for that section. The mill is on the east side of American Flat and is approximately two miles south of Gold Hill. A new town, known as Comstock, has been established there.

### Choice of Mining Method

The selection of a method of development and mining has been directly dependent on the geological conditions within the area of operations. The lode proper in this section is a faulted zone, striking slightly east of north, in andesite. The vein consists of quartz and andesite which has been more or less completely replaced by silica. From an elevation of about 5750 ft., the vein dips 40 to 50° to the east; above this elevation, it grows steeper, until, at an elevation of 5900 ft., it is almost vertical. From the Yellow Jacket shaft northerly for 900 ft., it continues vertically through to the surface. Fig. 1 illustrates the general conditions in this area. North of this point, or north of No. 12 crosscut, there is an overturn in the vein, and the vertical portion gradually bends to the east until a point is reached where the dip is as much as 45° to the west. This condition is illustrated in Fig. 2.

* Presented at the San Francisco Meeting, September, 1922.

† Superintendent of Mines, United Comstock Mines Company, Gold Hill, Nev.

[2] Bonanza Ores of the Comstock Lode. U. S. Geol. Survey *Bulletin* 735C.

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In the vein there were several parallel enrichments which formed the bonanza veins originally mined, and which now exist as ore-filled stopes. The westerly enrichment, commonly referred to as the "West Vein," and the easterly one, called the "East Vein," at various points merge into one. Where they do not, the intervening ground carries ore of sufficient value to warrant mining all or portions of it. The mineable portions are adjacent to the old stopes, forming a stope casing of varying widths.

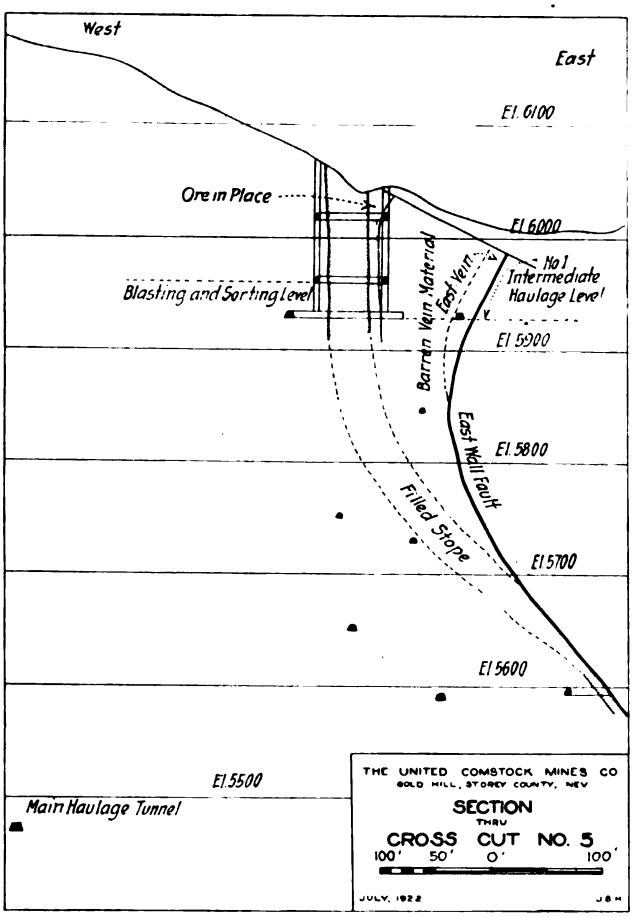


FIG. 1.—SECTION THROUGH CROSS-CUT NO. 5.

The wall, west of the West Vein, is an altered andesite, locally kaolinized, and containing an intricate network of small clay seams. On the east, the quartz is bounded by a distinct fault, marked by a band of dense, blue clay, beyond which the andesite is thoroughly shattered, highly kaolinized, and contains numerous clay seams. Both the east and west country rock adjacent to the lode require substantial timbering for either drifting or raising. Where dry, the ground gives little trouble after the timber is in, but the presence of even a small amount of moisture causes swelling and necessitates the use of top and side bridging and spiling.

To deliver the ore to the mill, a tunnel was driven in the foot wall, or west wall, sufficiently near the lode not to make crosscutting to it excessive, and far enough away to avoid its being endangered by subsequent mining operations. This tunnel is 9250 ft. from the portal to the north end and has a cross-section of 8 ft. 0 in. by 8 ft. 6 in. in the clear. The first 3500 ft. was in ground requiring little or no timbering, but from this point in, with the exception of a few short stretches, the tunnel had to be timbered. At the north end, the tunnel is 700 ft. below the surface and approximately 1000 ft. above the Sutro drainage tunnel level. It is run on a 0.5 per cent. grade in favor of the load and a ditch has been carried on the west side for its full length. All the water passing through this ditch will be diverted to the mill. The equipment consists of 60-lb. rail, laid to 30-in. gage, and solid-bottom cars, of 10-ton capacity, which will be handled by two 8-ton trolley locomotives operated in tandem. The cars will be dumped at the coarse-ore pocket of the mill by a rotary dumper, which is operated by compressed air and handles four cars at a time.

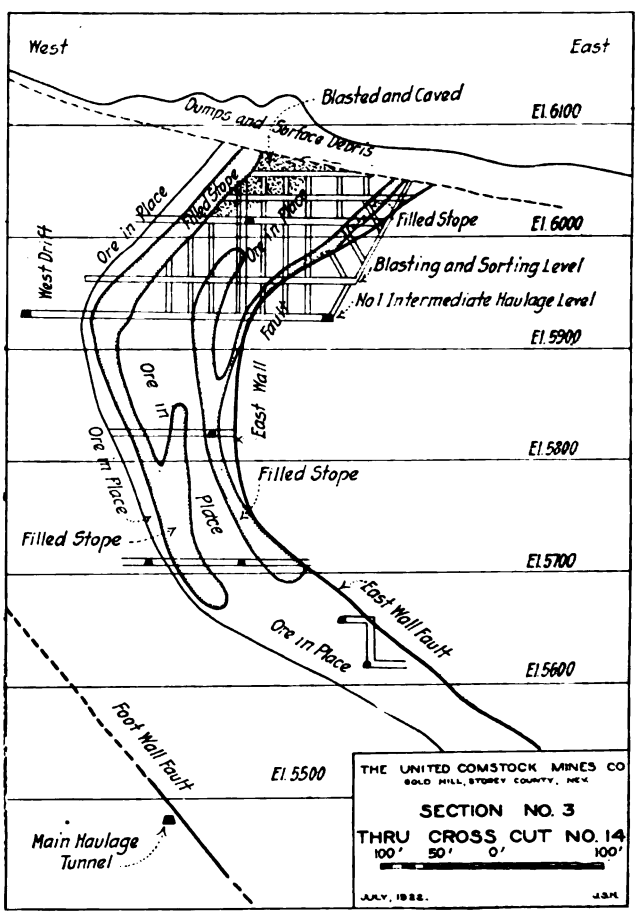


FIG. 2.—SECTION THROUGH CROSS-CUT NO. 14.

To mine the ore above the elevation of the main haulage tunnel, three intermediate haulage levels will be driven, dividing, vertically, the area to be mined into four sections. These three intermediate haulage levels will be from 175 to 190 ft. apart. The upper haulage level is now being driven, as the ore above this will be the first attacked. This level is an adit at an elevation of 5930, which is the elevation of the collar of the Yellow Jacket shaft. This fact has aided the speed with which

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the development work could be carried on, as it gave an outlet on the surface near the Yellow Jacket shaft, and obviated the necessity of doing a great deal of work through shafts.

### Ore-passes

To get the ore from the upper haulage level to the main haulage level, ore-passes "C," No. 5, No. 15, and No. 19 are being driven between these levels. Their locations are shown in Fig. 3. These are 9 ft. 0 in. by 8 ft. 0 in. over all and divided into a chute compartment and manway. The manway is 2 ft. 0 in. by 6 ft. 4 in. in the clear and the chute compartment is 4 ft. 6 in. by 6 ft. 4 in. in the clear. All are cribbed with 10 by 10 timber, and between the cribbing 10-in. blocks have been driven, with the ends projecting into the chute compartment 3 to 4 in. beyond the line of the cribbing. These blocks are designed to protect the cribbing from wear. On the manway side of the chute, port holes with covers are provided every 10 or 15 ft., for barring in case the ore should hang up.

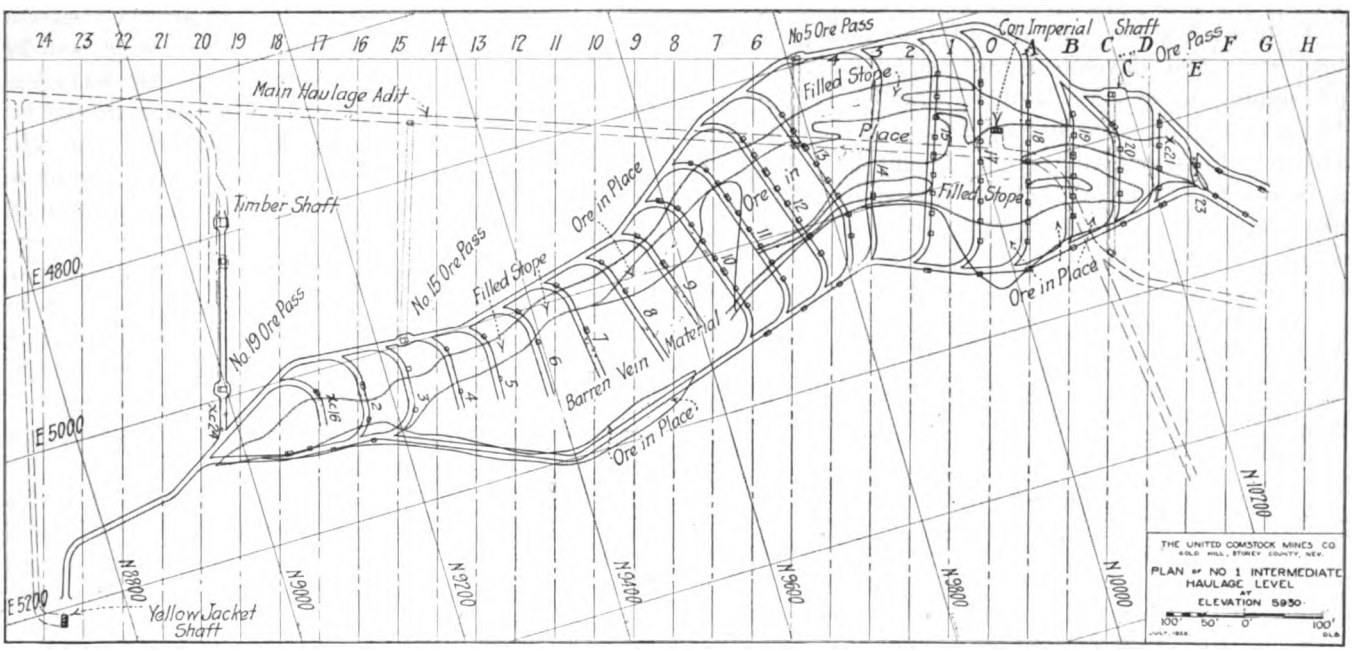


FIG. 3.—METHOD OF DEVELOPING UPPER HAULAGE LEVEL, SHOWING LOCATION OF RAISES.

### Development and Mining

Fig. 3 shows the method of developing the upper haulage level and the location of the raises through which the ore will be transferred to this level. The ore from the raises will be transferred to the ore-passes by 2-ton Granby-type cars and storage-battery locomotives. The general layout of this level consists of two drifts, one on the west side and one on the east side of the orebody. From the west, or foot-wall drift, crosscuts are turned off every 55 ft. and on the northern end connect through to the east, or hanging-wall, drift. All of the ore-passes from the main haulage tunnel connect with the foot-wall drift.

A sub-level is being opened 25 ft. above the first haulage level, and all raises are driven to this sub-level. They are then offset the width of the raise and continued through to the surface, on the south end, and to the hanging wall, where possible, on the north end. Grizzlies are to be installed over these raises at this sub-level, and all large chunks will be blasted there. The timbers from the old stopes will be removed also and handled at the grizzly chambers.

The southern portion of the orebody will be mined as a milling pit as long as the side walls make this method safe. The portion to the north will be blocked out, starting 25 ft. below the top of the ore, in pillars approximately 25 ft. square. These are to be drilled and blasted, but only sufficient ore is to be drawn off to permit working on the unmined pillars. As this work is going on, a second sub-level, 25 ft. below, will be developed, on which the same process will be carried out. This will give 50 ft. of broken ore up to the hanging, and an endeavor will be made to maintain this thickness of broken ore to protect against dilution in subsequent mining. It is expected that the third sub-level can be carried down 35 to 50 ft., or further, and drawing off from the old stopes and the new pillars will then be regulated by the amount that can be taken and still keep the top of the ore horizontal. The southern portion, which will first be mined as a milling pit, later will be attacked along the same lines.

The ore must be drawn as evenly as possible, and to do this much the same system as is in use at one of the porphyry coppers will be followed. This consists in making frequent cross-sections, and in estimating the ore in place, and by regulating the daily product from the various raises to keep the top of the ore as nearly level as possible.

The methods outlined undoubtedly will have to be modified in various ways to meet conditions as they arise.

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# Design and Construction of United Comstock Mills *

By Walter L. Reid †

THE United Comstock Mines Co. is a subsidiary of the Metals Exploration Co. Its properties were acquired in June, 1920, and the work of designing and constructing plants for the treatment of its ores was assigned to the engineering staff of the Metals Exploration Co. The men directly in charge of this work have been: Walter L. Reid, consulting milling engineer; A. J. Weinig, metallurgist; Lee L. Fillius, superintendent of construction; B. P. Little, chief draftsman, in charge of engineering office; Robert McF. Doble, in charge of power and electrical engineering.

Tests made at the instance of former owners of these properties had developed the recommendation that all sliming in cyanide solution practice be adopted. Inspection of actual milling operations in the Comstock District, supplemented by a special mill run of 100 tons, gave rise to the belief that the prevailing practice of grinding to 90 per cent. through 100 mesh in cyanide solution was not necessary nor justified by results; further, that this practice occasioned too high a consumption of cyanide, measured by the value of the ores. Laboratory tests confirmed this conclusion, and demonstrated the presence in the ores of soluble salts, which proved to be the cause of the large consumption of cyanide.

A plant for testing 1000-lb. lots of ores was then installed at the mines. Tests conducted there demonstrated the necessity of a preliminary washing of the ores in water to remove the soluble salts before the application of cyanide solutions. One example of the results so obtained will be of interest. Two lots of 1000 lb. each were treated, one without preliminary washing, the second with washing of the ores before treatment by cyanide. The results were:

| | First Test (without Washing) | Second Test (with Washing) |
|---|---|---|
| Cyanide consumption | 4.06 lb. | 0.68 lb. |
| Lime consumption | 22.70 lb. | 6.52 lb. |
| Extraction of values | 89.0 per cent. | 91.60 per cent. |

Other tests proved that the salts were readily soluble when the ores had been reduced to through ¼-in. mesh, thus establishing the work to be done in the dry-crushing department. It was demonstrated also that fine grinding need be conducted only to pass between 16 and 40 mesh, instead of 100, thus materially reducing installation and operating costs. Under this practice it also proves possible to leach approximately 60 per cent. of the mill feed, and through concentration, in advance of all cyanide treatment, to concentrate approximately 40 per cent. of the valuable content of the ores to 2½ per cent. of the original tonnage, thereby confining the extremely fine grinding to a small quantity of concentrate, which is given intensive treatment.

A full year was devoted to other ore tests, to the selection of mill equipment and to the design of necessary mill buildings. Ground was broken on July 1, 1921, but the construction of the plants was considerably delayed by an unusually severe winter.

The milling plant consists of the coarse-crushing plant, the fine-grinding and concentration plant, and the cyanide plant. There are eight auxiliary buildings; the ore pocket, conveyor gallery, substation, machine shop, plate or blacksmith shop, warehouse, precipitation and refinery building, and assay office with testing plant.

## The Coarse-crushing Plant

The coarse-crushing plant is a reinforced concrete structure throughout, 192 ft. long, 46 ft. wide, and 79 ft. extreme height. It contains a pan conveyor (No. 1); three 30-in. belt conveyors, each driven by an individual motor; two Allis Chalmers No. 7½ Gates gyratory crushers; one set of Power Mining & Machinery Co.'s 72-in. Garfield rolls, driven through a counter shaft by a 200-hp. motor; two sets of 54-in. Garfield rolls, one driven through a counter shaft by a 150-hp. motor and one by a 200-hp. motor of an older type; six Mitchell vibrating screens, and sampling plant for continuous cutting out and reduction of sample. All of these are served by one 20-ton hand-power crane, running the length of building and out to the shops and railroad spur.

Rolls and conveyors are arranged in close circuit with the Mitchell screens. The product of the Mitchell screens drops on the third belt conveyor, known as conveyor No. 4; this in turn is fed to No. 5 conveyor, which runs at a right angle to No. 4 through a conveyor gallery, 250 ft. in length, thence over weightometer into fine ore bins of 3200 tons capacity.

From the feed to No. 5 conveyor, a sample of 150 lb. will be cut at intervals of one minute, making a cut of 80 tons from each 2000 tons. This sample is automatically fed through the sampling plant, consisting of one set of rolls and one special Vezin sampler, thus cutting the sample down to 3000 lb. This is retained in a bin for additional reduction by rolls, goes thence through a Vezin sampler, followed by a sample grinder, to obtain 400 lb. of sample to be cut further by hand. The reject from the sampling plant is continuously fed to No. 5 conveyor.

## The Fine-grinding Plant

The fine-grinding plant is a reinforced concrete structure, 240 ft. long, 89 ft. wide and 83 ft. extreme height, containing ten 56-in. Akins classifiers for primary wash to remove soluble salts; five 7 by 6 Allis Chalmers ball mills, each direct connected through a herringbone gear to a 150-hp. motor; one 5 by 12 ball peb-mill for regrinding concentrate; one small 3 by 6 ball mill for grinding lime; two Dorr classifiers for returning middling to ball mills; two 15-ft. Dorr bowl classifiers; also feeder belts

* Presented at the San Francisco Meeting, September, 1922.

† Consulting Milling Engineer, Metals Exploration Company, Telluride, Colo.

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from bins to Akins classifiers, and from Akins classifiers to ball mills. The overflow from the bowl classifiers, consisting of the secondary slimes, is sent direct to the thickening department of the cyanide plant.

A 20-ton crane is arranged over the ball mills, the crane-way running over the supply yard and into the machine shop. This crane-way is at right angles to the crane-way of the coarse-crushing plant, and loads can be interchanged by the cranes.

The upper floor of this building contains 32 Deister Machine Co. Plat-o tables, which are fed by two elevators (each arranged with a duplicate for spare), which carry the oversize from the Dorr bowl classifiers. The tables make a concentrate which is reground by the ball peb-mill in circuit with two tables and flows to the re-treatment tanks. A middling is returned to the ball mills and the sand tailing flows to the leaching tanks.

The elevators lift 65 ft. They are fitted with 30-in. belts and are driven by individual 30-hp. motors, direct connected to the elevator head shafts through a Fawcus herringbone-gear speed reducer, which reduces the speed from 900 to 26 r.p.m. The gears are enclosed and run in oil, and have a flexible coupling on each side of the gear sets.

## The Cyanide Plant

The tank house is a steel frame building 325 by 296½ ft. in plan, center to center of column lines, covering 96,600 sq. ft., or 2¼ acres. A bay 36 ft. wide extends along the west side and contains the Moore filter plant. In the remainder of the building, interior columns are placed at each corner of 64-ft. bays (except that exterior bays are 66½ ft.). The tallest of these interior columns is 74 ft. 11 in. from the bottom of the base plate to the upper gage line of the roof truss. Intercepting main trusses extend from column to column. These carry intersecting trusses dividing each bay into three panels. This arrangement allows the use of 60-ft. thickeners and storage tanks without interference from building columns. The roof is designed for a 40-lb. snow load per sq. ft., and for a maximum wind load of 20 lb. per sq. ft., with 16,000 lb. per sq. in. maximum fiber stress in tension members, reduced in the usual ratio for compression members. The total weight of columns, roof trusses, wall girts, etc. (exclusive of filter bay crane girders) is 441 tons, or a trifle less than 9.2 lb. per sq. ft. of area. This was selected from a number of designs, as it was the most economical arrangement by over 200 tons. The roof is sheathed with 1¾-in. tongued and grooved Oregon pine, attached directly to steel purlins, and covered with 20-gage galvanized corrugated steel. One-third of the side-wall area is Fenestra steel sash, 17,500 sq. ft. being used. The wall proper will consist of 28-gage galvanized plain sheets attached to the steel frame. Between this and the outside wall of 24-gage corrugated galvanized sheets will be placed two layers of tarred building paper, each layer weighing 15 lb. per 100 sq. ft. The sheets are fastened together at close intervals with stove bolts and galvanized rivets, and the outer sheets attached through the inner plies to the steel frame with the usual galvanized steel wire clinch nails. It is expected that this insulation will give a satisfactory radiation factor and not appreciably increase the fire hazard.

The building contains 40 redwood tanks, arranged as follows: Six, 60 ft. in diameter by 16 ft. deep, for leaching; five, same dimensions, fitted with trays for double-deck thickener mechanisms; two, same dimensions, for solution-storage tanks; nine, 30 ft. in diameter by 24 ft. deep, fitted with Dorr agitator mechanisms; five, 30 ft. in diameter by 24 ft. deep, and four, 20 ft. in diameter by 25 ft. deep, for various solution storage; also three, 35 ft. in diameter by 6 ft. deep, fitted with Dorr thickener mechanisms and five, 15 ft. in diameter by 20 ft. deep, fitted with Dorr agitator mechanisms. The latter thickeners and agitators compose the concentrate re-treatment plant.

The sheathing in the roof and the tanks is the only wood in the plant.

The tanks rest on concrete sills placed directly on the reinforced concrete floors of the building. All pipe connections and outlets from these tanks are carried in tunnels or culverts under the floor, there being 2600 ft. of these tunnels. The runways or operating floors around tanks and superstructures carrying shafting and mechanisms have structural steel supports, with pre-cast concrete slabs for floors and walkways. There are 260 tons of interior structural steel in addition to 441 tons contained in the building frame as mentioned above, making a total of 700 tons of structural steel used in the tank house. There are 46 miles, or 88 tons, of tank hoops.

The filter plant consists of 16 concrete tanks, 27 ft. long, 9 ft. wide and 11 ft. deep, each with three hoppers in the bottom to insure rapidity and ease of draining. These are cast as one monolithic block. The tanks are fitted with 12 baskets, each containing 62 leaves 6 ft. by 8 ft. and are served by two electric cranes of 40 tons capacity. These are arranged for a complete transfer of basket from tank to tank in 2½ minutes.

The tank house is conveniently arranged for the gravity flow of the pulp throughout, except for one transfer of the primary slime by pump (containing a minimum proportion of the granular pulp) from the filters to the agitators and arranged so as to confine practically all pumping to clear solutions. Attention has been given throughout to the application of direct-connected motors, except where belt-driven are more convenient to operate.

Precipitation is accomplished by the zinc-dust method, using four 32-frame 52-in. Merrill presses with Crowe vacuum.

Eight miles of pipe was used in the interior of the tank house, or a total of 10 miles for the mill operations through the buildings described, exclusive of the water service lines outside.

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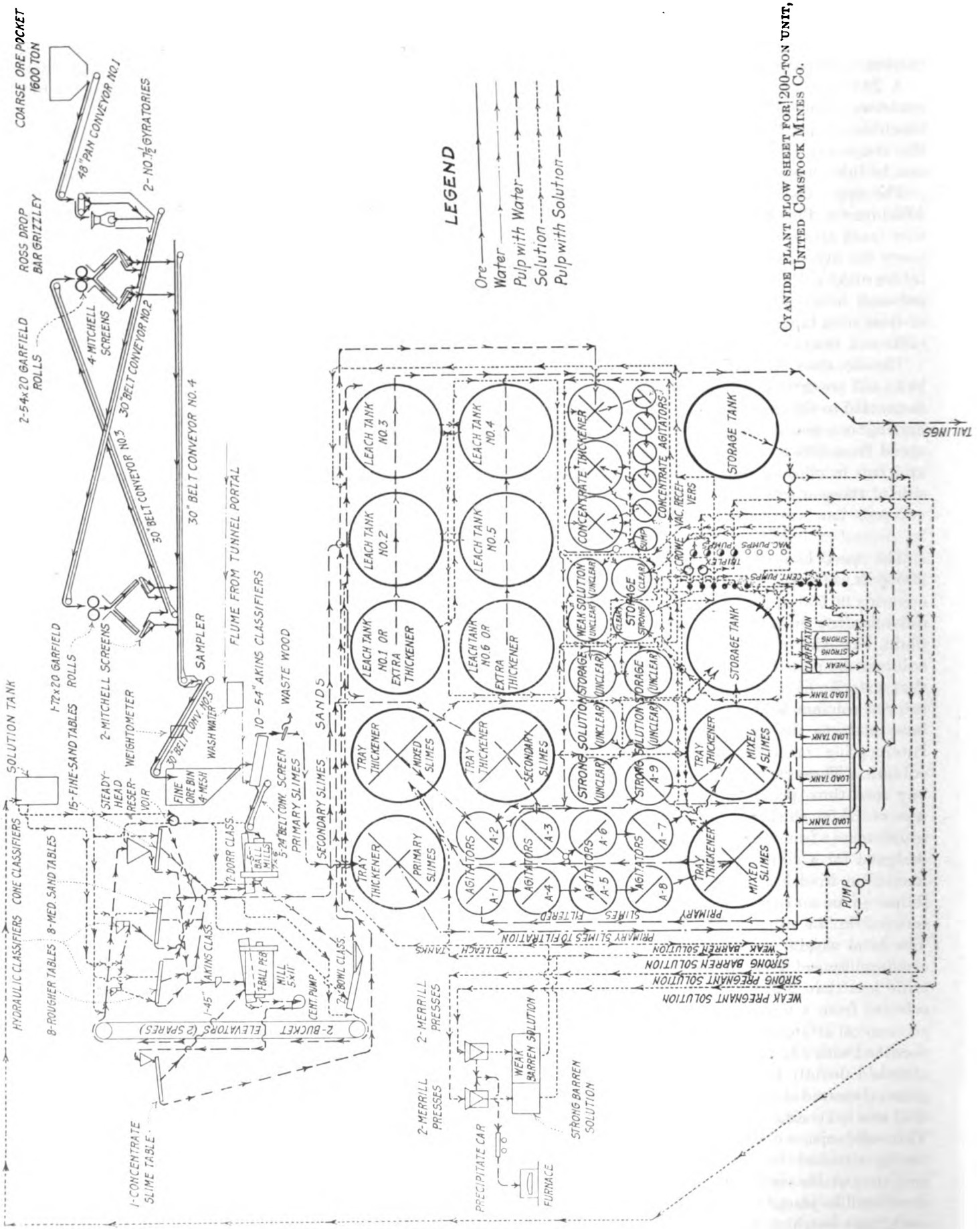


CYANIDE PLANT FLOW SHEET FOR 200-TON UNIT, UNITED COMSTOCK MINES CO.

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The precipitation and refinery building is a reinforced concrete structure throughout, 112 ft. long, 32 ft. wide and 24 ft. high, to the eaves. One-half of the first story forms two rectangular tanks; above these is the floor supporting the four Merrill presses, the remainder of the building being devoted to the refinery containing a reverberatory furnace for melting, and a vault for bullion storage. The doors and windows are guarded with heavy grate bars.

The machine shop is 32 ft. high to the eaves and has a floor area of 50 by 80 ft. The easterly 30 ft. is under the ball mill supply yard craneway and the machine shop has a 15-ton hand-power crane on this runway for its own use. The floor and side walls for a height of 4 to 6 ft. (to window-sill horizon) are reinforced concrete, above which is a reinforced concrete skeleton frame with panels mostly filled with Fenestra steel sash, a few panels being closed with corrugated galvanized steel. The shop is arranged so that work can be handled into large machines by crane.

The plate shop is separated from the machine shop by the rigging bay of the coarse-crushing plant; a space 32 by 50 ft. in which the spare roll shafts will be overhauled and fitted with new shells.

A 30-in. gage track (mine gage) extends lengthwise through the supply yard, machine shop, across the rigging bay, through the plate shop, and connects to the mine track system.

The plate shop is 32 ft. wide, 48 ft. long and 19½ ft. high to the eaves. The construction is the same as that of the machine shop.

The warehouse is a solid concrete building 32 by 96 ft. by 13 ft. high to the eaves, situated on a railroad spur. It contains a storekeeper's office and is provided with cases containing 3000 receptacles for small items of stock. There is 1000 sq. ft. of floor space for storage of larger items. The warehouse is surrounded by a concrete platform 8 ft. wide and 4 ft. above the yard level.

The assay office and testing plant is a two-story building 38 by 66 ft. The first story is of reinforced concrete and contains equipment for testing and sample grinding machinery. The second story consists of a steel frame covered with metal lath and cement plaster, inside and out. It contains the furnace room, laboratory and mill superintendent's office.

The total motor installation for the 2000-ton milling and treatment plant is 2800 horsepower.

## United Comstock Metallurgy*

By A. J. Weinig†

THE ores now developed and considered for delivery to the United Comstock mills are to be derived from depths under 700 ft. from the surface and will be obtained in part from mine fills, containing timber in all stages of preservation, and in part from the mining of virgin ore. The haulage tunnel, which intercepts the ore deposit, has developed some warm water of sufficient purity for milling purposes.

In general the average ore may be classified as oxidized quartzose vein matter, containing a variable amount of clays and ochers and some valuable sulfides and other minerals. The valuable metals are essentially gold and silver, existing in a ratio of about one of gold to forty of silver, by weight. The ores contain a large amount of organic matter and are rather unusual in that inorganic salts are also present in abundance.

The ores vary from soft to very hard, but as a mean they possess a high coefficient of grinding resistance; local operating mills are motored for 2 hp. per ton daily capacity for crushing and grinding equipment alone.

The settling and thickening properties of the ore are usually good, provided the ore is naturally free of soluble constituents or has been washed free of them. Local operating mills manage well with 5 sq. ft. settler area per ton of ore per day on clean or washed ore, even when grinding to 200 mesh.

The sulfides are mainly pyrite with smaller amounts of argentite and its alteration products, which usually contain copper. The pyrite shows numerous irregular inclusions of alabandite, argentite, quartz, gypsum, gold and silver. The free metal inclusions are very small and exist as minute skeleton forms in crystallites and microlites. The inclusions of argentite are both irregular and in crystal form. Pyrite is often entirely enclosed in gypsum crystals; indeed, crystalline pyrite has been observed even in stalactites and stalagmites composed of water-soluble salts that have leached from the ore and deposited in the mine drifts.

The gold exists in the ore almost entirely free, though alloyed with considerable silver and some copper. Allusion has already been made to its association with pyrite, but gold also exists in the interstices of the quartz crystals as minute spongy grains, very often containing numerous irregular inclusions of quartz, all of which frequently show extinction together under the polarizing microscope.

The silver with the quartz exists mainly as argentite and its derivatives. Some silver is free, usually in wire form, some is present as chloride, and some traces are soluble under conditions that might lead one to believe it combined as sulfate.

Silver is present in an insoluble form associated with manganiferous ochers, but mainly so in surface ores where peroxidations are most pronounced. Some of this silver is rendered soluble by simple selective reduction treatment and some is relentlessly unyielding until all of the manganese has been reduced and the ore completely bleached.

The large amounts of soluble matter in the ore are mainly due to the presence of the sulfates of iron, manganese, zinc, copper, sodium, potassium, calcium

*Presented at the San Francisco Meeting, September, 1922.

†Superintendent of Mills, United Comstock Mines Company, Gold Hill, Nev.

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and magnesium, with some rare earths in very small amounts. The accompanying analysis shows in a general way the more important salts content of the ores from the various mine horizons. The level number roughly indicates the depth of the horizon below the ground surface. The amounts of constituents are represented as pounds per ton of ore. The mean ore shows about 15 lb. of salts per ton. On a 2000-ton milling basis, the daily entry of salts to the mill will be 15 tons.

*Analysis Showing More Important Salts of Ores from Various Mine Horizons, United Comstock Mines**

Pounds per ton of ore

| Constituents | Surface Tunnel Yellow Jacket | 360 Yellow Jacket | 200 Level Imperial | 300 Level Imperial | 400 Level Imperial | 470 Level Imperial |
|---|---|---|---|---|---|---|
| $FeSO_4$..... | 0.054 | 1.206 | 2.724 | 2.580 | 3.428 | 6.80 |
| $Al_2(SO_4)_3$.... | 0.014 | | 0.630 | 1.032 | 0.844 | 1.340 |
| $MSO_4$..... | | 0.0614 | 0.802 | 0.126 | | 0.786 |
| $MnSO_4$..... | 0.124 | 0.448 | 1.622 | 0.566 | 0.626 | 1.136 |
| $CaSO_4$..... | 0.700 | 9.304 | 4.768 | 3.050 | 4.322 | 4.186 |
| $MgSO_4$..... | 1.300 | 5.180 | 6.638 | 5.664 | 6.854 | 11.928 |
| $CuSO_4$..... | | Trace | Trace | Trace | Trace | 0.020 |
| Total solids.. | 2.234 | 16.282 | 16.218 | 12.426 | 15.700 | 26.062 |
| Total water. | 25.800 | 20.420 | 31.400 | 16.600 | 17.400 | 29.800 |

The tabulated analysis requires but brief review. The amounts of ferrous iron and manganese sulfates are serious with reference to the chemical consumption of cyanide. Indeed, on several levels the amount of these salts would render the cyanide process impractical unless they were removed. The sulfates as a whole cause very high lime consumption and the aluminates with magnesium hydrates, formed by such reactions with lime, gelatinate and mingle with the ore and thereby seriously impair the settling, thickening and filtering properties of the ore pulps.

In a very general way, the salts content of the ores increases with depth; the surface ores appear to have been leached downward. As might be expected, the ore is gypseous and mill solutions in this district are always saturated with reference to calcium sulfate.

## General Description of Process

The ore is to be dry crushed to four-mesh size, at which point the soluble matter in the ore is quickly and easily dissolved in warm water. This crushing is followed by a brief replacement wash in simple mechanical classifiers, using a minimum amount of warm mine-tunnel water. The washing produces a filterable slime overflow and a sand discharge, which quickly drains to from 10 to 14 per cent. moisture. The slimes are screened to remove wood and are sent direct to thickeners where the aluminum sulfate and magnesium sulfate, dissolved out of the ore, act as flocculants and cause fairly rapid settlement of the slimes. The foul water in the thickener overflow is used in sluicing out the mill tailings. The washer discharge sands are sent direct to regrinding units where the first contact of the ore with cyanide solution takes place.

The primary slime removed in the washing presents the most formidable metallurgical problem. It represents from 10 to 13 per cent. of the total ore weight, and averages 50 per cent. more metal content than the head ore. It is from 25 to 50 per cent true Brownian slime. The manganiferous ochers concentrate therein, which accounts for its higher silver content. It is the highest cyanide-consuming portion of the ore even after perfect washing. When overflowed at the washers at 80 mesh it is filterable, yet further grinding fails to yield higher solubility of the metals. When overflowed finer than 100 mesh, filtration becomes difficult and impracticable.

The thickened primary slime is sent to leaf-type filters, where a loading of from 3 to 4 lb. of dry slime per sq. ft. of filter surface can be made in from 28 to 30 minutes. The cakes thus made are washed, transferred to stock mill solution, and the retained moisture displaced with cyanide solution. Due to the higher initial cyanide consumption of this slime, a displacement of filtrate solution that is very low in cyanide, but high in value, is obtained. This solution is precipitated and then discarded. The amount of displacement with mill solution is carried to a point that balances the moisture entry into the mill circuit, due to the moisture left in the washed ore from the washers' discharge. After replacement the cakes are discharged and pumped to agitators where the pulp receives preliminary treatment; from these the pulp joins the secondary slimes in treatment, which will be described later.

The washed four-mesh ore, after regrinding, is deslimed in solution in bowl classifiers; these yield an overflow of secondary slimes and a deslimed discharge, which is sent to table concentrators. The secondary slimes are sent to thickeners and the discharge thereof, combined with the primary slimes, receives ordinary slime agitation treatment, solution replacements and filtration on leaf-type filters before being discharged as tailings.

The tables produce a concentrate, which is sent to the concentrate treatment plant, a middling and concentrate to be returned for regrinding, and a sand tailing, which is sent to the leaching plant. Hydraulic classification produces graded sands ahead of the tables and also cleanses the sands of any slime that might have escaped the bowl classifiers. The leaching sands therefore are doubly protected from the entry of slimes.

The leaching plant operation will be ordinary, with possibly the added requirement of blowing the sands with low-pressure air, similar to Homestake practice. The Comstock ores greedily absorb oxygen and it is evident that the soluble-oxygen requirement of solutions is unusually important.

The concentrate treatment will consist of very fine

* Made by M. F. Coolbaugh, Manager Research Dept., Metals Exploration Co.

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grinding of the concentrate in a ball peb-mill, followed by classification of the ball peb-mill discharge on table concentrators. Only the finest slimed concentrate will thus succeed in passing to the concentrate treatment plant settlers. The middling and concentrate from these concentrators are returned for regrind. The thickening and agitation of the slimed concentrate will be continuous, and cyanide strengths up to 20 lb. per ton of solution will be used. The plant is flexible, allowing three direct charges of solution. The concentrate offers little difficulty to direct treatment. Perhaps here a little lead salt, there a little mercury salt, combined with fine grinding, strong solution and moderate solution temperatures, is all that is required. Mercury will be introduced into the mill solutions with the working up of Gold Canyon dredge sands with the concentrate. The presence of mercury is entirely desirable and beneficial.

After concentrate treatment the concentrate pulp is discharged to the regular slime plant and receives its filtration and elimination in the tailings, mixed with the general slimes.

### Summary of Ore-treatment Processes

A general summary of the foregoing processes shows that in treatment the ore is split into six products, each product receiving a treatment peculiar to its needs, or is eliminated from treatment, as the case may be:

| Product | Approximate Per Cent. of Total Ore by Weight | Approximate Relative Value Per Ton Ore Heads Taken as Unity | Remarks |
|---|---|---|---|
| 1. Wood pulp..... | 0.30 | None | Eliminated in washing |
| 2. Salts (with water of crystallization) | 1.50 | Trace | Eliminated in washing |
| 3. Primary slime... | 10–13 | 1.5 | Special treatment |
| 4. Secondary slime. | 30–50 | 0.5 | Ordinary slime treatment |
| 5. Sands..... .... | 40–60 | 0.2 | Leached |
| 6. Concentrate..... | 2– 4 | 20.0 | Special treatment |

It is evident that the washing out of the primary slime removes from the grinding plant the usual high dissolution normally made in grinding, and this increases materially the dissolution effected in agitation and thickening. Advantage is taken of this feature in removing from the settling and agitation circuits the higher grade solution for precipitation. Before precipation, however, this solution is passed through the leaching plant and concentrate treatment plant, thus stepping it up quite high in value before it enters the precipitation process.

Clarification is effected in part in the leaching plant and in part with baskets of filter leaves, which are separate but standard units, integral with the regular filter plant. The Crowe vacuum process will be installed.

Melting will be conducted in an oil-fired reverberatory furnace, similar to Mexican practice. The furnace will have a movable hearth and the wet, but fluxed, precipitate will be charged from cars through the roof of the furnace, thus reducing to a minimum the handling of precipitate.

## Lehigh University's New President

THE fifty-sixth anniversary of the founding of Lehigh University, on Oct. 14, was marked not only by special Founder's Day exercises but by the inauguration of Dr. Charles Russ Richards, formerly dean of the College of Engineering at the University of Illinois, as president of Lehigh University. The induction address was made by Dr. Henry R. Price, of Brooklyn, N. Y., who is president of the Board of Trustees.

Dr. Henry S. Drinker, president emeritus of Lehigh, represented the A. I. M. E. at the inaugural ceremonies.

## Carnegie Students Work Nights in Steel Mills

TO ASSIST students who are working their way through Carnegie Institute of Technology, the Jones and Laughlin Steel Co., of Pittsburgh, has arranged to employ students in the steel mills on Friday and Saturday nights, or all day Saturday. The shifts are 10 hr. long.

Jones and Laughlin is the first large concern in Pittsburgh to come to the aid of students in need of finances. The arrangement is pleasing to the administration at Carnegie Tech because of the opportunity it gives to the students in the College of Engineering to acquire practical as well as theoretical knowledge.

## American Mining Congress Officers

THE following officers were elected at the Twenty-fifth Annual Convention of the American Mining Congress: president, Sidney J. Jennings; vice-presidents: Daniel B. Wentz, H. W. Seaman, E. L. Doheny; directors: Daniel B. Wentz, William Lindsay, W. C. Doering, Albert Nason.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Brazilian Centenary Exhibition. | Rio de Janeiro, Brazil | To Mch. 31, 1923 |
| Soc. Naval Architects.... | New York, N. Y. | Nov. 8–9 |
| Amer. Soc. Mech. Engrs. | New York, N. Y. | Dec. 4–7 |
| Soc. Econ. Geologists.... | Ann Arbor, Mich. | Dec. 28–30 |
| Natl. Exposition Power & Mech. Engng..... | New York, N. Y. | Dec. 7–13 |

**Crushing Strength of Iron Ores.**—Tests to determine the crushing strength of numerous samples of iron ore obtained by the U. S. Bureau of Mines in the Birmingham, Ala., district are to be made at the Carnegie Institute of Technology at Pittsburgh, Pa. The samples to be tested are in the form of cubes cut from masses of iron ore.

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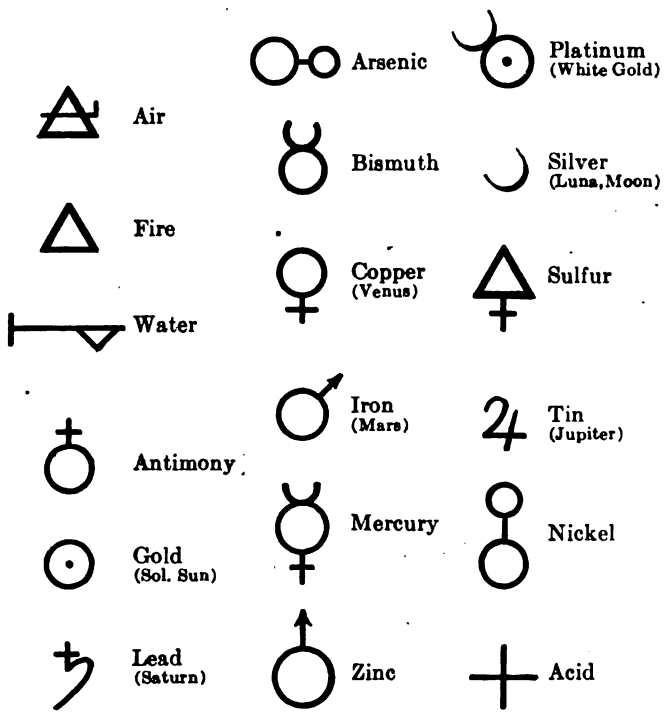
## Alchemistic Symbols for Now Common Metals*

THE pursuit of new knowledge, one modern phase of which is scientific research, has always met opposition. So strong was this opposition by the established order in olden days that it sometimes led to social




abasement, torture or death. Hence the necessity for secrecy and the use of symbols.

By slow stages an art grew which came to be called chemy and later alchemy. Very early in the days of alchemy, the commoner substances were represented in writings of the alchemists by symbols, as also were many operations of their art. The origins of these symbols are sometimes easily recognized; sometimes the symbols seem to have been products of fancy. Among the most ancient are those used for the metals; their germ is to be found in the earliest days of history.

In the misty times of the past, there lived on the great plain at the head of the Persian Gulf a race whose wisdom was famed to surpass that of all surrounding peoples. In the clear atmosphere of that region they watched from the summits of high mounds the stars and the planets, seeking to trace a connection between the heavenly bodies and the affairs of earth. Here, among the Chaldeans, was born astrology, the mother of astronomy. Here, too, are found the beginnings of alchemy, which three thousand or more years later was to develop into the science of chemistry.

The Chaldeans associated the metals known to them with the planets, and believed that through their influence the metals grew in the earth. The planets in turn were closely connected with the gods and goddesses of the pantheon of mythology. This threefold association of metals, planets and divinities seems for many centuries to have been dormant, but was revived by the alchemists, and by them the metals were always called by the names of the planets. In gold was typified the bright yellow glow of the sun; in silver, the soft white light of the moon; in iron, the weapons of Mars, the war-god; in copper, Venus Anadyomene, rising, full-formed, in all her beauty from the ocean's foam on the shore of the island of Cyprus, from which comes the name of copper. Lead, which, however we may polish it, soon loses its brightness, was the metal of Saturn, dullest of all the gods. Tin, known in early times only in bronze, its alloy with copper, was the metal of Jupiter, who, under the name Bel, was always associated by the Chaldeans with Venus, called by them Beltis. Finally, in quicksilver was found the fitting type of Mercury, fleet-footed messenger of the gods. Some of these designations have been retained even to the present: quicksilver is commonly known as mercury, silver nitrate is called lunar caustic, and saturnine poisoning prevails among lead workers.

In the old alchemistic writings we find the names of the metals very generally written with the astronomical symbols of the planets, and from these symbols has been developed, through many changes, the present simple system of one-letter and two-letter abbreviations used in modern chemistry.

When platinum was discovered, it was first called *l'or blanc* (white gold), and hence to it was given a symbol combining those of gold and silver, platinum resembling gold in its noble qualities—being unattacked by any single acid, unoxidizable, fusible with difficulty and of high specific gravity—and resembling silver in its color. Many other and more obscure symbols were gradually introduced, until in one alchemistic manuscript of the early part of the 17th century no less than 22 symbols and 33 distinct names are used for mercury alone.

With all its ignorance, as we now consider it, and with all its deceit, it was out of this maze of alchemy, with its transmutation of metals and its philosopher's stone, that the chemistry of today was at length evolved.

* Abridged from a brochure by James Lewis Howe, Washington and Lee University, written for Baker & Co., Inc., of Newark, N. J. Issued by Engineering Foundation: A. D. Flinn, Director, 29 W. 39th St., New York.

## Blast Furnace Progress in France

A REPORT of the "Comité des Forges," received by the Bankers Trust Company of New York from its French Information Service, gives the number of blast furnaces in operation in France as having increased from 91 in July to 94 in August, as a result of greater activity in the metallurgical centers. The number of furnaces ready to work are 62 and the number of furnaces in construction or under repair are 64. The newly lighted furnaces are in the east of France and in Alsace-Lorraine.

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# Sampling and Estimating Ore in Copper Queen Mines*

By R. W. PROUTY† AND R. T. GREEN‡

Copper Queen Branch, Phelps Dodge Corpn., Bisbee, Ariz.

THE methods of sampling and ore estimating used at the Copper Queen Branch, Phelps Dodge Corpn., as applied to the Copper Queen mines at Bisbee, Ariz., fall into two divisions because of the difference in occurrence, manner of prospecting, and methods of mining: that for the underground operations and that for the Sacramento Hill steam-shovel operations.

The orebodies of the Warren district may be divided into three classes: Replacements of limestone, replacements of porphyry, and replacements of contact breccia. The first class is more or less intimately related to porphyry intrusions, although in badly fractured country this relationship may not be well shown. These orebodies are mainly oxide and carbonate ore and very irregular, both in size and outline, although usually roughly lenticular and following the bedding of the limestones. There is usually quite a sharp boundary between the ore and waste in the carbonate and oxide orebodies and sampling is not necessary to determine the limits of commercial ore. In the sulfide orebodies it is exceedingly difficult, without sampling, to determine the boundary between commercial ore and the surrounding low-grade or barren pyrite. Calculations made a few years ago showed that these orebodies had an average thickness of 35 ft. As some of the orebodies have a thickness of from 100 to 300 ft., it can be seen that the smaller ones form a difficult problem both in prospecting and in estimating.

## Sampling Necessary to Determine Boundary

In the replacements in porphyry, both underground and in Sacramento Hill, the boundary usually cannot be determined without sampling. There is a gradual decrease in metal content until barren material is reached; this gradation may occur within a short distance or may extend for several yards.

Surrounding the Sacramento Hill porphyry stock is a wide zone of contact breccia composed of fragments of porphyry and limestone, all intensely silicified. Within this mass have been found many replacements of sulfide, some barren and some carrying enough copper to constitute ore. These deposits are extremely irregular, as to location, size and copper content, and offer some of the most difficult problems of prospecting. No set of conditions especially favorable to their formation has been recognized, and without sampling it is impossible to determine whether a certain mass of sulfide will be commercial ore or not.

## Sampling Methods for Underground Operations

Different kinds of samples are taken in the mines, depending on the reason for which the information s desired:

*Grab samples*, taken by the shift boss or foreman, are used as a guide in mining operations.

*Chute samples*, taken from the cars as loaded by carmen under shift-boss orders, are used to determine the grade of ore mined in a certain section for the shift or day. Once a month, a complete analysis is made of a composite of the daily chute samples from each stope. This analysis is used in figuring minimum grades for mining in each section of the mine.

*Belt or shipment samples* are taken by the sampling department from the loading belt at the main hoisting shaft and from the mine cars, when dumped, for the ore that is not hoisted. These samples give production figures for the day and 15-day period, and are checked against the samples taken at the smelter. These samples, adjusted to conform to those from the smelter, form the base on which calculations are made to show the actual grade mined in each stope for the 15-day period. As separate belt samples are taken for each loading pocket at the shaft and a record is kept of the ore passing through each one, an accurate adjustment is possible between the belt samples and those taken at the chutes.

*Channel or groove samples*, taken by the sampling department, are used for records of ore passed through in development work and for estimating grade of ore developed before stoping commences. Channel samples are taken in the stopes when difficulty is experienced in determining points at which material below the minimum grade desired is being mined. These samples are taken with a pick, hammer, and moil, or a light air hammer fitted with a moil point. Channels average about 1 by 4 in. and, in uniform ground, are taken for 5-ft. intervals. Where there is an abrupt change from ore to waste, or especially rich seams are found,

* Read at San Francisco meeting of A. I. M. E., September 1922, but not published in pamphlet form.

† Chief Geologist.

‡ Assistant Chief Engineer, Surface Operations.

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the sample is divided and the length of sample in each material is noted. In locating channel samples, the common precautions in regard to direction of sample with relation to structure and of cleaning the surface of oxidation products are observed.

In the oxide and carbonate orebodies, little channel sampling is done, as the change from ore to waste usually is easily recognized by an experienced man. In these orebodies, the chute samples give the information desired. In the sulfide orebodies, however, channeling is essential to determine the boundaries of "pay ore." Most of these orebodies are channeled before stoping commences and as necessity arises during the extraction period.

Assay maps show all channel samples and a comparison of chute and belt samples and mine and smelter samples made up for each 15-day period. The average difference between the chute and belt samples is about 0.4 per cent. and between the shipment samples taken at the mine and smelter, about 0.2 per cent., on a copper content of about 7 per cent.

### Ore-estimating Methods for Underground Operations

Prior to 1913, estimates of two classes of ore were prepared by the engineering department: ore in sight and probable ore. The first class was calculated by extending known faces of ore 10 ft. into the solid. The estimates of the second class of ore were based mainly on the judgment of the man making the estimate. Grades were given in round figures and again represented the opinion of the estimator. In 1913, the ore estimation was transferred to the geological department, where the present reserves are calculated. Semi-annual estimates are prepared on Jan. 1 and July 1, but estimates of various orebodies or areas are made when desired by the management.

For the calculation of ore reserves, the detail figuring is done in bound books 10 by 12 in., the completed calculations are transferred to cards 5 by 8 in., one card being used for each orebody. Summary cards, one for each division of the mine, are also made up, as well as general summary cards for the entire mine. The latter show not only the tonnage remaining in the mine but also the change since the previous estimate and previous year, the footage of development work, tonnage mined, total tonnage developed and tons mined and developed per foot of development work done.

The general principle underlying the calculation of ore reserves is a critical study of the individual orebody under consideration, its history, present condition, and geological relationship. The methods used for estimating the reserves in the limestone orebodies is determined by intimate knowledge of the orebody; Sacramento Hill porphyry deposit is estimated separately and by a different method. The methods are:

1. From horizontal sections, where the total volume of the orebody is calculated, the tonnage mined is deducted to secure the reserve.
2. From horizontal sections where only the ore remaining is estimated.
3. From vertical sections where the total volume is calculated and the tonnage mined deducted.
4. From drifts and raises that cut ore in which no other work has been done.
5. From the sill floor of a stope with no work done below it.
6. From stoping operations of other companies on the property line, but with no work done opposite them.
7. Where orebodies are following the same porphyry dike or fractures.

In the construction of sections for estimating, all available information from drifts, raises, winzes and intermediate work is used. Not only is account taken of sampling results but geological features and their relationship to the ore are considered.

The first method above is used where the orebody is fairly regular and where the tonnage mined can be obtained easily. The second method forms an important part of the estimating practice as a large number of orebodies are calculated by it at present. In this method, the area of ore remaining at an elevation is taken for a height corresponding to the floor of the stope at which it occurs; for example, sill floor 10 ft. and stope floor 8 feet.

In the third method, where possible, vertical sections are spaced at intervals, up to 50 ft., depending on the location of raises. Areas of ore are not connected between levels unless raises have gone through practically on the section. To obtain the reserve, the tonnage mined is deducted from the total volume of the orebody. This method is the most desirable, on account of irregularities in vertical extent of the orebodies and is used whenever the necessary information is available.

Where ore is encountered in drifts or raises, it is figured as extending for 10 ft. beyond all free faces, unless known to end within that distance. In the past this has meant a block 28 by 25 ft. for drifts, taking the length of ore in the drift for the third dimension, and 25 by 30 ft. for raises, for the distance the raise was in ore. Where a sill floor of a stope has no work below, the sill area is projected downwards 10 ft. Where ore is mined by the other companies up to the property line and no work has been done opposite, the area on the line is projected 20 ft. into Copper Queen ground.

In a few places, orebodies that are following the same porphyry dike or fracture are connected for distances not exceeding 100 ft. This method was used much more in the past than at present.

The weight of the ore is taken from actual weights of broken ore, determined at intervals by the engineering department and applying an expansion factor of 1.6 to 1. By averaging the weights obtained since estimating by the geological department started, 9 years ago, an accurate figure has been secured, which is not changed according to individual weighing of ore. This weight factor varies from 0.057 to 0.110 and is applied to the estimated volume to reduce it to tonnage figures.

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Ore grades are figured on past production of each orebody. For this purpose the original estimate made by the geological department was given a grade based on an average of all chute samples taken. In later estimates, this figure has been corrected by averaging with it the grade mined in the six months preceding the estimate. By disregarding the tonnages represented in the two figures averaged, it is assumed that the ore remaining will be more nearly of the grade just previously mined than that of preceding periods. In using this method for ore reserves, the economic aspect of the operations of the previous period must be considered. In other words, it is necessary to consider whether especially rich portions of the orebody have been mined, or whether the grade obtained can be assumed to be more or less that of the entire deposit. In one section of the mine, the grade of the orebody is calculated from channel samples alone. This is an extension of the disseminated ore of Sacramento Hill that will not be included in the steam-shovel operations.

The tonnage in this orebody is calculated from vertical sections and the grade arrived at by taking a careful geometrical average of the samples on each section. Two sets of sections, at right angles to each other, are used and the results obtained from the two estimates averaged for the final figures. Few samples used with one set of sections appear in the estimate from the other set, but the results have been found to be remarkably close both as to tonnage and grade.

### Summary of Underground Methods

To summarize briefly, the Copper Queen experience has shown that, for orebodies of the type of those in the Warren district, the following points apply:

1. Systematic sampling of oxide and carbonate orebodies is not essential.
2. Massive sulfide deposits must be carefully sampled to determine the boundary between ore and waste.
3. Careful and detailed sampling of disseminated orebodies is a necessity.
4. Vertical sections are the most accurate means of estimating.
5. All available geological information must be used to secure accurate figures on reserves.
6. Only about three years supply of ore, in limestone replacement deposits, is developed ahead of stoping on account of the difficulty and expense of maintaining openings in them and loss of interest on money involved.
7. Ore estimates are of value to show the comparative condition of the mine rather than its probable life.

Preliminary to the systematic development of Sacramento Hill with churn drills, an accurate contour map of the region, on a 50-ft. scale with a contour interval of 5 ft., was made. This map was laid out in 100-ft. squares. Drilling was started as nearly on the corners of these squares as the nature of the ground permitted.

During the process of drilling, water was poured into the hole to form a sludge with the cuttings. Material samples were taken at intervals of 5 ft., all of the cuttings from the 5 ft. going to make up the sample, whether the sludge was bailed out more than once or not while the distance was being drilled.

### Sampling and Estimating at Sacramento Hill

Among the errors peculiar to this method of sampling are: The tendency of the hole to cave; the concentration of heavy minerals in the bottom of the hole; and the deflection of the hole from the vertical. The first of these was largely remedied by casing the hole when it was found necessary. The error arising from the concentration of heavy mineral in the bottom of the hole was negligible, because the cuttings were so thoroughly mixed by the drilling tools that the heavier particles had practically no time to settle out before the sludge was removed by the bailer. Also, at the taking of each sample the hole was cleaned as thoroughly as possible. As nearly as has been determined, there has been little difficulty because of holes deflecting from the vertical; several holes were checked where they penetrated underground workings and the deflection was very small, considering the depths of the holes drilled. As several of the drill holes pierced underground workings, it has been possible to check the accuracy of the churn-drill method of sampling by driving raises along the holes. The general results obtained from these raises agree closely with those obtained from the drill holes.

### Estimating Ore Reserves

From the information furnished by the assay office and the sampler at the drill, a log of each hole was made, which showed the location and value of each sample in depth. The ore in each hole was grouped into classes according to grades, as follows: Samples that assayed better than 3½ per cent. copper, "S" ore; from 1¾ to 3½ per cent., "E" ore; from 1.3 to 1.75 per cent., "C" ore; from 1 to 1.3 per cent., "F" ore; from 0.8 to 1.0 per cent., "L" ore; from 0.5 to 0.08 per cent., "P" ore. With these logs as a guide, cross-sections of the orebody were made both ways through the orebody at intervals of 100 ft. along the sides of the squares before mentioned. If a hole did not come exactly on the section, but was several feet away, the information contained in the hole was projected to the section and recorded there, the distance and direction of the hole being noted. These cross-section sheets were used to show the general form of the body, and the relation of the different classes of ore to each other and to waste intrusion. They were not considered accurate enough for use in making the final estimates of ore tonnages. These estimates were made by the triangular-prism method, as follows:

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Using the cross-section sheets, together with the logs of the holes as a guide, a triangular plat on a 50-ft. scale was made, the apexes of each triangle being a churn-drill hole. Considerable care was necessary in making these divisions, so that each triangular prism would be of equal value. This divided the whole orebody into a series of triangular prisms, the edge of each prism being marked by a churn-drill hole. From the log of each drill hole, the ore reserves were calculated.

The number of feet of each class of ore is multiplied by its assay value, which gives the feet per cent. of each class of ore. The total footage of each class of ore divided by its feet per cent. gives the average content of that class of ore in the hole. Three of these holes form the edges of a triangular prism. Each triangular prism is given a number and its volume and grade are calculated separately. The results from each triangular prism are tabulated and give the total volume of each class of ore together with its assay value.

In converting the volume into tons, it was found, after determining the specific gravity of the ore, that for "S," "E," "G," and "F" classes of ore, 12 cu. ft. equaled 1 ton, and for "L," "P," and "waste," 13 cu. ft. equaled 1 ton, These factors were used in determining the tonnage of each class of ore and also the total tonnage.

Summarizing the above, holes were drilled through the orebody at the intersections of 100-ft. squares and these holes sampled at 5-ft. intervals. Logs of the holes were made showing ore by grades and classes. The orebody was divided into a series of triangular prisms, the edges of each prism being churn-drill holes. The average value of each prism was calculated separately and the results summed up for total ore in the orebody.

## Electrical Precipitation of Solids from Smelter Gases*

By Ross B. Rathbun†

THE fundamental principles of the process in its simplest form are set forth. It is shown why the Cottrell process during recent years has in a large measure supplanted the bag-house and dust chamber in treating smelter gases.

The commonly accepted theory concerning the manner in which the dust particles are charged and precipitated is given. It is pointed out that the thing most important to the operating man is how the particles may be enabled to give up their charge to the electrodes under all conditions, rather than the manner in which they receive it.

The various types of treaters in common use are described and discussed. The advantages of straight line treaters over those in which the gases are by-passed are emphasized.

It is shown that the gas is ionized much more efficiently for a given power consumption and the construction simplified and reduced by arranging the electrodes in the flue so that their electric fields are in series with each other. It is shown that this is accomplished by causing the gas to flow parallel to the electrostatic lines instead of at right angles to them, as in all other types.

The factors of lead and copper metallurgy are given which control the amount of sulfuric acid and water vapor in the gases. It is also pointed out that these things are a measure of the successful operation when treating smelter gases.

The physical rather than the chemical structure of the dust in suspension is shown to be the all-important matter. Several theories are given as to why flue dust is so much easier to precipitate than fume. A number of photomicrographs are given to illustrate the difference in physical structure between fume and dust.

Two methods are featured of obtaining sufficient conductivity in a dry precipitated coating to permit the electric charge to leak through it to the electrode. The theory of selective absorption is advanced as an explanation of how aqueous vapor added to the gas stream functions in this respect. The method of adding very finely atomized sulfuric acid is shown to be the most practical, because it does not have certain disadvantages of the water and its higher boiling point permits a wider field of application. Its action is shown to be due to the fine acid particles being precipitated with the dust particles, thereby imparting conductive film to the particles by diffusion.

The amount of free sulfuric acid in grams per 1000 cu. ft. of gas which permits a good precipitation on gas without conditioning is given from tests made on a large installation.

The theory of back ionization and phenomena of discontinuous dielectric are discussed. Electrical matters are shown to be secondary to treater design and to the conditioning gas. All that can be expected of electrical equipment is to stress the space between electrodes to the economical limit. Local conditions must govern choice of electrical equipment.

The tendency to regard electrical phenomena, such as surging, which as a rule accompanies poor precipitation, as causes rather than effects, is cited. Effects of conditioning gas in reducing surges is shown.

Internal reactance in transformer best suited to precipitation work is discussed, also possibility of exceeding the practical limit and wasting power on treatable gas by carrying voltage up to the point of disruption; necessity of knowing electrical values in the treater, and these are best obtained with milliammeter and electrostatic voltmeter; finally, the subject of proportioning the plant investment between electrical equipment and treater is covered.

* Original abstract of article (8000 w.) in *Journal* of the American Institute of Electrical Engineers, September, 1922.

† American Smelting & Refining Co., Salt Lake City.

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# Abstracts of Institute Papers

The following papers will be printed in full in pamphlet form. A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 24 of the Advertising Section. Discussion of papers is invited.

## Outline for Papers on Bituminous Coal Mining Methods

THE Mining Methods Committee has prepared an Outline for Papers on Bituminous Coal Mining Methods, similar to the outline published some time ago for papers on mining methods in general. This pamphlet is listed on the Request Blank this month.

## Interpretation of Results of Coal-washing Tests*

By Thomas Fraser and H. F. Yancey, Urbana, Ill.

THE interpretation of data secured in coal-washing tests is difficult because of the many factors that must be considered. Methods are presented here for expressing numerically the relative values of the different operations. For operating commercial plants, a combination of older sink-and-float formulas is recommended. A yield ash curve method is proposed for comparing the yield secured by washing with the yield of float coal of the same quality. In work with tables a system of separate receiving compartments will permit direct comparison of yields. Suggestions are made for determining relative values of different operations on a commercial basis. The most profitable operation, generally, is the one that produces the maximum yield of washed coal sufficiently clean to meet the requirements.

The first step in the investigative work is to determine, from the characteristics of the coal and the manner of occurrence of the impurities, whether it is possible to separate the dirt from the coal and produce a washed coal of the required quality. Then it is necessary to select the type of washer or the system of treatment that will produce the greatest amount of washed coal of this grade for the least cost.

To secure this information, tests may be made at laboratories operated by consulting or contracting engineers, at the testing plants of machinery manufacturers, at commercial washeries, or in an experimental washery erected on the site of the proposed plant. Such tests will produce figures in which every factor, including analyses of raw coal and washed coal and yield of washed coal, may vary widely. To reduce these results to a common basis for comparison is very difficult. A number of plans have been proposed for reducing, by means of charts or formulas, the results of a washing operation to a single figure which represents, as a percentage, the general efficiency of the operation, and which may be compared directly with a similarly deduced efficiency number for another operation. Another method is to study each set of results as a whole and in relation to one another and then, taking into consideration all the conditions obtaining to decide which results are the most favorable. The efficiency-formula method of reducing the results of each test to a single figure, so that a direct numerical comparison may be made, is the simplest and most precise method of comparing the results of competitive tests and is preferable if the number secured by the efficiency calculation truly represents the effectiveness of the operation.

In the experimental work conducted, for several years, at the Urbana station of the Bureau of Mines, an attempt has been made to develop a systematic method of conducting an examination into the washability of a coal and of evaluating the results of experimental work. A careful study has been made of published efficiency formulas and some have been developed, that later have been discarded as useless. The conclusion reached is that a formula that may be applied indiscriminately to all cases and conditions to produce efficiency numbers for direct comparison is out of the question. Some of the methods that have been found useful are described in this paper and their limitations are outlined.

### Difficulty in Comparing Experimental Results

The difficulty of interpreting experimental data is illustrated by the results of a series of competitive coal-washing tests.

For a given coal, the percentage of fixed impurities, or the minimum ash and sulfur securable in the clean coal product of a sink-and-float test holds more or less constant with, however, some increase in the very dirty samples. This would lead us to expect that, in washing coal carrying different percentages of impurities, the results would tend toward production of a washed coal approaching a certain minimum ash and sulfur content in every case rather than toward the

* New York Meeting, February, 1923.

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removal of the same proportion of the total dirt present in the raw coal.

It is not suggested, however, that the results securable on a lot of the same coal of different ash content be estimated by assuming the production of a washed coal of the same quality and then calculating the washer loss necessary to bring about this reduction in ash. Neither this calculation nor an assumption of the same percentage reduction in ash will take the place of an actual washing test on a truly representative sample.

### Comparison of Results by Drakeley Efficiency Formula

A method advanced by T. J. Drakeley is based entirely on specific-gravity separations secured by the float-and-sink method. The improvement in the character of the washed coal over the raw coal, with respect to the concentration of float particles in it, is termed by Drakeley the qualitative efficiency of the process. If, therefore, the washed coal consists entirely of particles that float on the test solution, the qualitative efficiency is 100 per cent. The manner of calculating the qualitative efficiency is as follows:

$$\text{Qualitative efficiency} = \frac{\text{Washed coal float}^1 - \text{Raw coal float}^1}{100 - \text{Raw coal float}}$$

By a second equation, Drakeley measures the effectiveness with regard to the recovery of float coal, by determining the amount of float in the refuse obtained, using a float-and-sink bath of the same specific gravity as was used for the raw coal and the washed coal. This factor is termed the quantitative efficiency and is derived as follows:

$$\text{Quantitative efficiency} = \frac{\text{Raw coal float} - (\text{Refuse float} \times \text{percentage of refuse})}{\text{Raw coal float}}$$

Assuming a case of perfect washing with no float coal in the refuse, the quantitative efficiency would obviously be 100 per cent. In order to obtain a single figure that represents the mechanical efficiency of the washing operation as a whole, Drakeley combines the qualitative and quantitative percentage efficiencies as a product; this is called the general efficiency of the process.

From a consideration of Drakeley's method it is evident, aside from the actual efficiency of the process, that the magnitude of the number secured depends somewhat on the specific gravity of the liquid used for the sink-and-float tests.

Such a definition of coal and dirt is an arbitrary one. It would appear better to select a density that gives a float coal containing the maximum allowable content of ash for the particular use to which the coal is to be put. Other considerations should lead to the adoption of a float-and-sink bath of a specific gravity depending on the requirements to be met.

The qualitative efficiency factor of the Drakeley formula, being a measure of the increase in concentration of float particles in the washed coal, takes no account of the quality of the heavy material left in the washed coal. The error due to this condition is evident from the data which shows that almost all of the heavy clean slate of high ash content is removed and that the sink material remaining in the washed coal consists largely of middling particles.

[1] Values used are percentages of float coal.

### Proposed Formula for Comparing Washing Tests

A formula has been adopted which combines a quantitative factor, secured by comparing the actual yield of washed coal to the yield of float coal, with a qualitative factor, secured by comparing the actual ash reduction to the ash reduction secured by the sink-and-float method. In addition, this method has the advantage that an ash analysis is a more precise determination than the sink-and-float test particularly on a coal that contains considerable material only slightly different in density from the sink-and-float bath. The formula was derived by combining a factor, similar to Drakeley's expression for quantitative efficiency, with the first of a set of four equations published by G. R. Delamater, or by combining as a product the first of these four equations with the last part of the fourth to form a single formula applicable under all the four conditions described in that paper. This gives the following expression for the general effectiveness of the washery operation.

$$\frac{\text{Actual yield}}{\text{Standard yield}} \times \frac{\text{Actual ash reduction}}{\text{Standard ash reduction}}$$

or

$$\frac{\text{Yield of washed coal}}{\text{Yield of float coal}} \times \frac{\text{Raw coal ash} - \text{Washed coal ash}}{\text{Raw coal ash} - \text{Float coal ash}}$$

Standard yield and standard ash reduction are taken as the yield of float coal and the ash reduction secured by a sink-and-float test on the raw coal, using a solution that will give the most profitable separation in the case under consideration. The specific gravity of the solution to be used is determined by the method described by Delamater.

### Comparing and Interpreting Results

The foregoing formula has been used in the study of many operations and is thought to be the most generally applicable. It differs from the underlying principle of the method advanced by Delamater only by combining the two efficiency factors as a product rather than as a numerical average and substituting for the four formulas a single expression which eliminates some inconsistencies in the four.

The qualitative efficiency might be calculated on the basis of sulfur content but as the sulfur values are much more erratic than the ash and do not vary consistently with the specific gravity, the ash content is the more satisfactory.

For studying the work of a plant in commercial operation by means of an efficiency calculation, it is

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essential that the results be compared with a complete separation between dirt and refuse at the right specific gravity because the operation is not right if this separation is not made at the most profitable point. But in conducting competitive coal-washing tests to determine what type of washer or what method of treatment will best clean the coal under consideration, the problem is to determine which process will make the sharpest and most complete separation of the heavy particles from the light particles in the raw coal.

To develop a method for definitely and accurately comparing the results secured in competitive washing tests on tables, the experimental quarter-size tables in the laboratory were equipped with a number of tanks.

The determination of the most profitable separation and the necessary adjustment of the plant depend largely on the commercial conditions in the particular operation being examined. This is an important part of the work but one that often receives too little consideration, particularly when the experimental work is done by persons not directly connected with the operation of the property. A washed product of any given quality, within the limits of the coal, may be secured, but the lower the ash and sulfur content of the coal is reduced, the smaller will be the output of washed coal. The experimental work can be conducted to much better advantage, therefore, if the engineer in charge is thoroughly familiar with the commercial conditions, the use for which the washed coal is intended, the requirements to be met; the financial advantage of reducing the ash and sulfur below these requirements, the value of the unwashed coal, etc. These conditions will vary widely at different mines.

The great diversity of commercial conditions shows that the universal application of a formula to produce efficiency numbers for direct comparison of different plants, operating on different coals and preparing coal for different purposes, is of doubtful value. This is only one of the many variable factors that enter into and complicate the problem.

## Mining Methods in the Mineville (N. Y.) District*

By Earl C. Henry, Mineville, N. Y.

MAGNETIC iron ore was mined in Essex County, N. Y., during the American Revolution; Benedict Arnold is said to have mined ore near Port Henry to secure iron for chains and spikes for the Lake Champlain fleet. Details regarding the operations prior to 1804 are not easily obtained but work on a commercial scale appears to have been started about 1838. The Witherbee, Sherman & Co. was established in 1849. The property of the district is held in fee almost entirely by the mining companies.

The orebodies occur in the gneissic rocks. The typical occurrence of the ore in this district is in lenticular bodies with a parallel pitch to the southwest, and those occurring in the acid gneissic rocks are non-titaniferous. The ores occurring in the gabbros and anorthosites are high in titanium. The iron mineral in all the orebodies is crystalline magnetite averaging from 30 to 50 per cent. iron.

Magnetic iron orebodies of the non-titaniferous type are fairly regular. They are strictly conformable to the schistosity or gneissic structure of their hosts; formal spacing of diamond-drill holes is thus a matter of secondary importance. Dip, strike, and pitch are the controlling factors. Care is taken to locate a drill hole well within the side lines, which have been fairly well determined in the operated mine, and strictly on the strike line. So well established is the lenticular character of the greater number of magnetic iron mines that mathematical spacing by means of coördinates would lead to disastrous conclusions; the greater number of holes located on this principle would be barren, even a large lens or series of lenses might be cut only once or twice in a dozen holes.

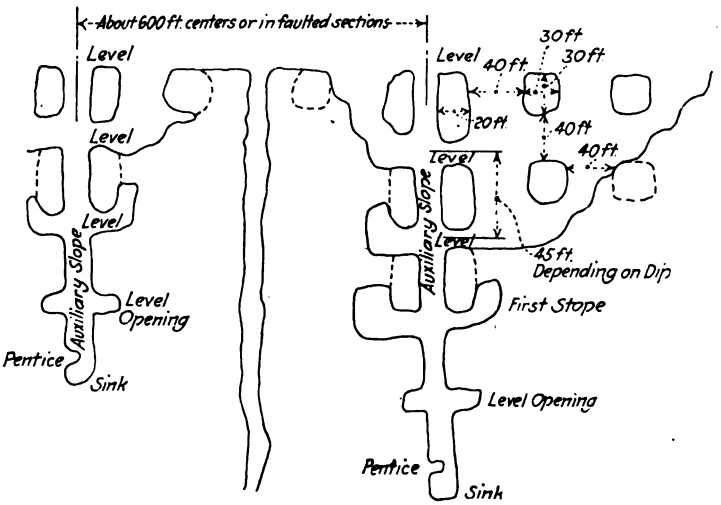


FIG. 2.—SKETCH OF METHOD OF MINING.

### DETERMINING SIZE AND ESTIMATING VALUE OF OREBODIES

Witherbee, Sherman & Co. has stressed the importance of core recovery; even in rock, 100 per cent. core is insisted upon within reason. As a result, 100 per cent. core in the ore horizon is the rule. The ore horizon is divided, by eye, into rich, lean, and very lean sections; each section of the core is split and the iron and phosphorus percentages determined. The completed analysis section may then read, for example,

1.5 ft., iron 47.5 per cent., phosphorus 0.55 per cent.
3.0 ft., iron 35.0 per cent., phosphorus 0.70 per cent.
2.0 ft., iron 20.0 per cent., phosphorus 0.48 per cent.
10.0 ft., iron 45.0 per cent., phosphorus 0.50 per cent.
16.6 ft.

* San Francisco Meeting, September, 1922.

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The general average, on a foot basis, is 16.6 ft. ore with an average iron content of 40.4 per cent. To provide against possible loss of core, sludge samples have been taken.

The method of estimating tonnage as the result of diamond drilling is comparatively simple in the orebodies of this company. The horizontal working face of one mine is, at right angles to the axis, 1850 ft. The average thickness of the ore and the percentage of iron is determined. Three drill holes were located at an average distance of 738 ft. in advance of working faces. The average thickness of the face working, of the ore shown in the drill holes, is the average thickness. This multiplied by the horizontal area gives the cubic feet of ore. Dip is disregarded, or allowed for possible errors. The tonnage, of course, will vary with the percentage of iron; if the cores show no diminution in thickness from working face, 500 or 1000 ft. in advance of drilling is reckoned as probable ore.

### Mining Methods Employed

The orebodies are inclined, dipping at an angle varying from 10° to 60°. The ore varies and is mined in thicknesses from 4 to 70 ft. Underhand stoping is used and pillars of ore are left to support the roof. No attempt is made to sort out the rock. All the broken material is sent to the mill. Timber is used only for tracks, stairways, and pocket faces. In the stopes, a bench is advanced in the heading and the ore is underhand stoped from this bench.

Mine sampling, in the strict sense of the word, is seldom done. The crude ore sent to the mill is sampled daily by passing a pan every half hour through the stream of ore after it has been crushed to 4 in. Inspection of working faces gives a close approximation of the grade.

In the Harmony mine, six Type O Thew shovels are being used to good advantage; three Myers-Whaley shovels are operated in the Old Bed mine.

Underground storage pockets of from 500 to 1500 tons capacity are provided at the head of each auxiliary slope and at the foot of the main hoisting slope. Skips operating in the auxiliary slopes dump the ore into the pocket, from which it is drawn into gable-bottom cars and transported to the main hoisting-slope pocket. From this pocket, the ore is drawn off into a measuring chute, holding a skip load, and delivered to the main slope skip by gates operated by air lifts.

All labor is employed by the day, except in stoping, drifting, and tramming; the stoping contract is figured by the ton, the drifting contract by the foot advance, and the tramming contract by the car.

| | Tons Per Man Per Hour | Man Hours Per Ton |
|---|---|---|
| Stoping | 4.6 | 0.217 |
| Development | 3.3 | 0.303 |
| All underground labor | 0.74 | 1.35 |
| Total organization | 0.43 | 2.33 |

The classification of labor for the total organization, with the mine operating at 60 per cent. of capacity, is as follows:

| | Per Cent. | | Per Cent. |
|---|---|---|---|
| Mines | 58.1 | Surface construction | 3.5 |
| Mills | 13.4 | Laboratory and testing plant | 0.6 |
| Electrical repairmen | 1.3 | Engineering | 1.0 |
| Foundry and shops | 6.7 | Office | 3.0 |
| Power plants | 4.2 | Hospital | 0.6 |
| Supply department | 1.2 | Watchmen | 0.1 |
| General surface | 6.3 | | |

The labor turnover for the year was 130 per cent.; this, however, does not mean that all new men were employed, it includes the men who drew their time and were away for over three days before returning to work. The total labor costs are 58 per cent. of the total cost of production.

The following results were obtained from explosives during the year:

| | |
|---|---|
| Operating | 1.40 tons ore per pound of powder |
| Development | 0.57 tons ore per pound of powder |
| Total operating and developing | 1.10 tons ore per pound of powder |

To place the ore in the head house requires 95. kw.-hr., which is distributed as follows: Mining (compressed air) 2.84 kw.-hr.; haulage, 0.56 kw.-hr.; hoisting, 5.30 kw.-hr.; pumping, 0.40 kw.-hr.; lighting, 0.40 kw.-hr.

The total cost of supplies used, expressed in per cent. of the total, is:

| | Per Cent. | | Per Cent |
|---|---|---|---|
| Explosives | 31.0 | Lumber | 4.6 |
| Oils | 0.6 | Tools | 0.7 |
| Pack and waste | 0.2 | Electrical supplies | 5.0 |
| Power | 24.6 | Air hose | 0.2 |
| Iron and steel | 9.8 | Wire rope | 2.6 |
| Castings | 3.1 | Miscellaneous | 8.9 |
| Bolts, nuts and washers | 5.9 | Shop supplies | 1.5 |
| Pipe and fittings | 0.9 | | |

Supplies cost 42 per cent. of the total cost of production.

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## Henry Marion Howe Medal

THE Board of Directors of the American Society for Steel Treating has set aside a fund to be known as the Henry Marion Howe Fund, the proceeds from which will apply on an annual medal to be known as the Henry Marion Howe Medal. This medal is established as a tribute to the exceptional contributions made by Doctor Howe to the science of metallurgy.

The medal will be of gold and will be presented to the author of the paper considered of highest merit on any subject within the field covered by the Society. The rules governing the award of the medal may be learned from the American Society for Steel Treating, 4600 Prospect Ave., Cleveland, Ohio.

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# Personal Notes and Biographies

**Edward W. Lawler** is general manager of the J. R. Alsing Engineering Co., of New York.

**H. H. Stoek** received the honorary degree of Doctor of Science from Lehigh University at the Founders' Day exercises on Oct. 14.

**V. J. Gudkov** has sailed for India, where he will be general superintendent at the Mysore Distillation and Iron Works, Bhadravat, State of Mysore.

**B. Britton Gottsberger's** address, as professor of Mining at Yale University, is Hammond Metallurgical Laboratory, Yale University, New Haven, Conn.

**Irving W. Edwards,** formerly with the National Carbon Co., is in charge of the recently organized firm of I. W. Edwards & Co., Sales Engineers, 220 Broadway, New York.

**Malcolm B. Kildale** received the M. A. degree at Stanford University this summer, and in September accepted a position as assistant geologist and engineer with the Compañia de Santa Gertrudis, Pachuca, Hidalgo, Mexico.

**Warren D. Smith,** who has been on leave of absence from the University of Oregon for the past two years, in charge of the Division of Mines, Bureau of Science, Manila, P. I., returned to the university on Oct. 1, to resume his work in geology and geography.

**W. Spencer Hutchinson** has been appointed professor of mining at the Massachusetts Institute of Technology. Professor Hutchinson graduated from the Institute in 1892, having studied in the civil engineering and mining departments. He is known as an authority on mine valuation and taxation and has done much professional work in Mexico, South America and Australia. For several years he has been consulting engineer for the Vanadium Corporation of America, and for many years has been a consulting mining engineer in Boston.

**George B. Waterhouse** has been appointed professor of metallurgy at the Massachusetts Institute of Technology. Professor Waterhouse was born in England forty years ago and received the degree of Bachelor of Metallurgy at Sheffield. He came to the United States in 1900, and obtained the degree of Doctor of Philosophy in 1906 at Columbia University. He is the author of numerous original scientific papers and the translator of a great number of French and German works on metallurgy. Since 1908 he has been technical director of the Lackawanna Steel Co. in Buffalo.

**John V. N. Dorr** recently returned to New York from a six-months' trip to England, France and Germany, where he inspected the installations of Dorr methods in the metallurgical and chemical plants. Mr. Dorr found considerable industrial depression in England. In Germany, he was impressed with the spirit of hard work which is evident on every hand, the absence of visible signs of poverty or suffering, the absence of wounded men, and the same evidences of precision and thrift which were so thoroughly characteristic before the war. In spite of its present financial condition he feels that Germany has unquestionably settled down to work and to solving the great problems of its industrial rehabilitation.

## Frank S. Washburn

FRANK SHERMAN WASHBURN, chairman of the board of the American Cyanamid Co., and formerly its president, died on Oct. 9 at his home in Rye, N. Y. He was born at Centralia, Ill., in 1860, the son of Elmer Washburn, former president of the National Livestock Bank of Chicago.

After graduating as a civil engineer from Cornell in 1885, Mr. Washburn entered railroad engineering in the Middle West. In 1889 he helped develop Purdy's dam and reservoir and other sources of New York City's water supply. Later he went to Chile as consulting engineer for the production and shipment of nitrate of soda. In 1916, he became president of the Goodman Mfg. Co. of Chicago, and a few years afterwards founded the American Cyanamid Co.

He is survived by his wife and two children, Frank S. Washburn, Jr. and Miss Elizabeth Washburn.

## Luther Wagoner

LUTHER WAGONER, consulting engineer, died at his home in San Francisco, on July 1. He was a member of the A. I. M. E., which he joined in 1897, and was also a member of the American Society of Civil Engineers.

Mr. Wagoner began his engineering work in 1866, serving first as deputy county engineer of Johnson Co.,

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Missouri, and then with the Union Pacific Railway. Later, he was engineer of the land department of the Texas Pacific Railway, and from 1874 to 1877 was in Brazil engaged in bridge construction, geodetic work and mine development.

With the exception of the years 1896 to 1900, which were given to general mining engineering practice, the larger part of his time was devoted to civil engineering work. He had charge of the construction of a section of the San Francisco sea wall, investigated the San Francisco water supply, and was chief engineer of the Havana sewer and paving contract.

Mr. Wagoner had a remarkable knowledge of mathematics and was well informed on subjects of general interest. He was an indefatigable student, and published many articles on engineering subjects.

## Charles T. Malcolmson

CHARLES T. MALCOLMSON, president of the Malcolmson Engineering & Machine Corpn. of Chicago, died on Jan. 10, 1922, after an operation for peritonitis.

Mr. Malcolmson was born in Canada in 1874, but received his degrees of B. S. (1897) and E. E. (1901) from the Armour Institute of Technology. He was chief engineer of the U. S. Commission at the Paris Exposition, 1899–1901; chief engineer of the West Indian Exposition, 1901–02, and superintendent of machinery at the St. Louis Exposition, 1902–03. Thereafter, he was in charge of several engineering operations, until 1912, when the Malcolmson Briquet Engineering Co. was formed.

Mr. Malcolmson joined the A. I. M. E. in 1907, and in 1918, while he was president of the Malcolmson Briquet Engineering Co., he wrote a paper on Carbocoal, which was presented at the Colorado meeting.

## Frank P. Howe

FRANK PERLEY HOWE died at his summer home in Bristol, R. I., on Aug. 24. Mr. Howe was born in Philadelphia, Sept. 19, 1852. He received his early education partly at the Episcopal Academy in Philadelphia, and partly in the public schools of Bristol. He graduated from Brown University in the class of 1872. After a year or two of work he entered Lehigh University and graduated in the class of 1878 with the degree of mining engineer.

After leaving college, he entered the iron and steel business, and for many years was manager of the Montour Iron Works at Danville, Pa. Later he was connected with the Wm. Wharton Co. of Philadelphia. At the time of his death he was president of the Cranberry Furnace Co., and the Cranberry Iron and Coal Co., both of Johnson City, Tenn.; of the Tennessee Western and N. Carolina Railroad Co., the Aldrich Pump Co. of Allentown, Pa., and the Allentown rolling mill.

For many years Mr. Howe spent all his spare time on his beautiful estate overlooking Mt. Hope Bay, a part of his father's farm, where he lived during much of his boyhood.

He is survived by his widow, Katherine (Woodward) Howe and two grandchildren, James Barnard and Frank Howe French.

## Necrology

THE deaths of the following members were reported to the Secretary's office during the month Sept. 15, to Oct. 16, 1922.

| Date of Election | Name | Date of Death |
|---|---|---|
| 1882 | Coolidge, Walter G. | Aug. 15, 1922 |
| 1917 | Dynan, Alan E. | Aug. 5, 1922 |
| 1907 | Malcolmson, C. T. | Jan. 10, 1922 |
| 1904 | Small, Harvey B. | Oct. 3, 1922 |
| 1916 | Washburn, Frank S. | Oct. 9, 1922 |
| 1880 | Witherbee, Walter C. | Sept. 28, 1922 |

# Correspondence and Discussion

## Salaries of Technical Men

I AM not one of those who believe in a union of technical men for the purpose of boosting salaries or fees, and while I feel that many technical men are not now receiving compensation in proportion to the value of their brains and the cost of developing those brains, I have little sympathy with those who complain to the Institute that it is neglecting their interests.

There is, however, something wrong somewhere, as instanced by the geologist who found it to his advantage to obtain a leave of absence for two weeks in order to paint his house, a journeyman painter's wages being nearly double his own salary.

And this brings me to the point of my own experience, which has probably been duplicated by many others.

I graduated from Yale and went to Chile for a large copper company, intending at the end of my contract

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to return to the states and take graduate work, probably at Columbia, in the hydrometallurgy of copper.

I left Chile before my contract expired in order to enter the service. With the cost of transportation and the little I received in the army, I did not have enough to take the work I wished, after being discharged from the army. I then spent some time in the Texas oil fields, and later went to Mexico, in the experimental department of a large smelting company. At the end of the year, the plant was shut down on account of the fall in the price of silver produced in foreign countries. I came back to the States.

I was able to borrow some money to put with what I had, and started some graduate work in metallurgy and geology at a large university, expecting that when I had finished this work, mining, etc. would be sufficiently revived to permit me to secure a position. I spent about two months looking for something in my line, and writing to different companies. No one had anything to offer although many suggested that I keep in touch with them, as something would surely turn up soon. I even took the state examination for petroleum engineer, Grade III and IV. Many took this, but so far I have heard of no vacancies. This position, by the way, pays $135 a month.

I finally got down to $1.50. With about one dollar more than enough to get to the oil fields, I came down here determined to get work, and got on a rig as a "roughneck." I am getting $7 a day; $210 a month, I may say, is better by $10 than I have ever received in any technical capacity. Compare this with the $135 mentioned above, which I believe requires that a man be a graduate of a university and have had one year (perhaps six months) experience in the field. My work now, as one of the "roughnecks" at the rig said yesterday, is best adapted to the man with a size 48 shirt and a number 5 hat.

With slight changes this account will apply to many other young technical men. I have met probably a hundred in the last two months who are willing to take anything, anywhere, at any salary.

Where does the trouble lie? Are we overstocked with technical men? Is this state of affairs simply due to the natural economic law of supply and demand? If so, it would appear that our universities are turning out more men educated for mining engineers than the industry can absorb.

I believe that the answer to the problem is not altogether simple, but one that is considerably involved and one which the Institute might possibly discuss to the advantage of the generation now studying mining engineering and to the advantage of the industry during the years to come.

Texas—Aug. 8, 1922. A MEMBER OF 1919.

# Institute Affairs

## Summary of Minutes of October Directors' Meeting

THE first fall meeting of the Board of Directors was held at Institute headquarters on Oct. 20, the following being present: Walter H. Aldridge, Sydney H. Ball, Percy E. Barbour, George D. Barron, William H. Bassett, J. Parke Channing, Galen H. Clevenger, Arthur S. Dwight, Karl Eilers, H. B. Fernald, S. J. Jennings, William Kelly, James F. Kemp, A. R. Ledoux, Robert Linton, F. W. McNair, R. V. Norris, Charles F. Rand, Forest Rutherford, W. L. Saunders, F. F. Sharpless, George Otis Smith and Chester W. Washburne.

As empowered by the Constitution, the Executive Committee had been acting in the interim since the last meeting and its actions were read in more or less detail and approved as follows:

*July* 17, 1922

To accept administration of fund for James Douglas Prize. President authorized to appoint committee to recommend to Directors a procedure for awarding the medal.

By authorization of Executive Committee and advice of counsel, advertising contract with Winston, Inc., terminated.

*July* 25, 1922

Appointment of Advisory Committee on MINING AND METALLURGY: W. R. Ingalls, chairman; A. R. Ledoux and Charles F. Rand.

Approval of visit of H. W. Craver to Denver and additional library expenditure of $75 as A. I. M. E. share.

Appropriations to Local Sections:

| | |
|---|---|
| Southern California Section | $250 |
| Chicago Section | 250 |

*Sept.* 6, 1922

Gift of Transactions to Engineers Club, Rio de Janeiro.

Report of Advisory Committee on MINING AND METALLURGY: favoring coöperation with *Mining Magazine* of London.

Committee of two to confer with committees from other Founder Societies to formulate basis coöperation between international technical bodies. A. R. Ledoux and Charles F. Rand appointed.

E. P. Mathewson elected member of Executive Committee in place of Edwin Ludlow resigned.

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*Oct.* 16, 1922

Approval of advertising contract with H. K. Hottenstein.

Approval of appointment of Irwin Hewlett Cornell on special committee of A. E. S. C. regarding pig lead.

Approval of admission of Department of Labor to American Engineering Standards Committee.

Request of The Mineral Club of Virginia Polytechnic Institute to become Affiliated Student Society granted.

Secretary instructed to write F. A. E. S. regarding future participation in F. A. E. S.

Report of receipt of $2000 from an anonymous donor as first contribution toward the Anthony F. Lucas Memorial medal.

President Dwight asked to suggest rules of award for Douglas Medal for 1923 and asked to appoint committee to receive recommendations of names of men eligible to receive the medal. President appointed A. R. Ledoux, Walter Douglas, W. R. Ingalls, A. L. Walker, G. C. Stone, H. A. Prosser, B. B. Thayer, C. F. Rand, A. S. Dwight.

Report of Treasurer and Finance Committee showed a slightly improved situation over estimate.

Report of Nominating Committee printed elsewhere in this issue.

Election of candidates for membership.

Dr. Federico Giolitti, a distinguished metallurgist of Italy, a son of the Prime Minister of Italy and of an illustrious family, was elected an Honorary Member of the Institute.

Contract between Bureau of Mines and A. I. M. E. to permit Bureau to employ a man to conduct milling investigations in coöperation with Institute's Milling Committee approved.

Appropriation of $50 for Annual Table of Physical Constants granted.

## A. E. S. C. Handling Many Projects

THE growing interest in standardization on the part of almost every American industry is emphasized by the quarterly report of the American Engineering Standards Committee, issued from the headquarters of the committee at 29 West 39th St., New York City.

Of the projects (106) that have official status before the A. E. S. C., 20 are concerned with mechanical engineering; 17 are civil engineering projects; 15 are electrical; 3 are automotive; 10 are concerned with transportation; 10 with ferrous metals; 11 with chemical; 5 with non-ferrous metals; 4 with mining; 2 with textiles; 1 with shipbuilding; and 8 with subjects of general interest.

Twenty-four standards or safety codes have been approved and 36 are up for approval. The remaining 46 projects represent codes and standards that are either in the process of formulation, or which are now being considered by committees of representatives, designated by the various bodies, industrial, technical and governmental, interested in each particular subject. In this way, more than 200 such bodies are officially participating in the work of the A. E. S. C. through their accredited representatives.

A regular interchange of information as to the status of work under way is maintained by the American Engineering Standards Committee with the national standardizing bodies of Austria, Belgium, Canada, Czech-Slovakia, France, Germany, Great Britain, Holland, Italy, Japan, Norway, Sweden and Switzerland. This information is issued in the form of quarterly reports and includes a statement of the status of each project on which work is actively under way.

## Nominations for Officers for 1923

THE official ticket formulated by the Nominating Committee for officers of the Institute for 1923 was submitted to the Board at its October meeting, in accordance with Article VII, Section 1, of the Constitution. It was approved, and is published herewith as directed:

| | |
|---|---|
| For President and Director: | E. P. Mathewson, Consulting Metallurgist, New York City. |
| Vice-President and Director: | T. T. Brewster, Vice-President, Mt. Olive and Staunton Coal Co., St. Louis, Mo. |
| Vice-President and Director: | Frank M. Smith, Smelter Director, Bunker Hill Smelter, Spokane, Wash. |
| Director: | W. H. Aldridge, President, Texas Gulf Sulphur Co., New York City. |
| Director: | G. H. Clevenger, Consulting Metallurgist, Boston, Mass. |
| Director: | A. N. Diehl, Assistant to Vice-President, Carnegie Steel Co., Pittsburgh, Pa. |
| Director: | Reno H. Sales, Geologist, Anaconda Copper Co., Butte, Mont. |
| Director: | Seeley W. Mudd, Mining Engineer, Los Angeles, Cal. |

The Nominating Committee was composed of the following: Robert Linton, chairman; Fred Crabtree, James F. Kemp, Walter E. McCourt, Arthur Notman, D. M. Riordan, Rush J. White.

## Domestic Manganese Resources

THE Secretary of War has asked the president of the Institute to supply him with a statement concerning the nation's resources of certain strategic minerals and their availability in the event of war. This inquiry has been referred to a general committee on Industrial Preparedness, and sub-committees on the various metals have been appointed to collect essential data and submit reports. One of the most important of these metals, manganese, has been assigned to this sub-committee.

The dependability of the conclusions in this inquiry will be measured by the quantity, accuracy and degree of detail of the data that can be obtained. It is the aim, therefore, to utilize all the sources from which data can be obtained. Many manganese deposits throughout the country have been examined by engineers and geologists since 1917 and many reports have been printed. There must be many reports in the hands of engineers,

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mining companies and owners that might be made available to the committee. The committee will consider summaries of estimated reserves for districts, but particularly wishes detailed reports of separate mines or deposits with maps (if possible), records of shipments (if any), representative analyses, prospecting records, etc.

Will you coöperate? Material submitted to the committee will be considered confidential if it is so requested, and after examination, will be returned. If you cannot send original material, will you submit essential details on blanks that will be sent to you, or furnish material to be consulted at your office? By coöperating, you will assist the Institute in performing an important public service.

Send material or write at once to C. M. Weld, 2 Rector St., New York City.

The Sub-Committee on Manganese:
C. M. Weld, Chairman,
D. F. Hewitt,
John A. Mathews,
Bradley Stoughton.

# Local Sections and Affiliations

## Local Section Meetings

**Boston.**—Meets first Monday of each winter month.

**Columbia.**—Holds four sessions during year. Annual meeting in September or October.

**New York.**—At the meeting to be held on the evening of Nov. 8, at the Machinery Club, the subject of discussion will be Coöperation Between Employers and Employees.

**San Francisco.**—Meets second Tuesday of each month.

## Columbia Section

THE Columbia Section held a luncheon meeting on Oct. 6, at which Ivan de Lashmutt spoke briefly about the northern Montana oil fields, where he has spent several months in geological study. By request, Mr. de Lashmutt promised to amplify his remarks and present a paper on the subject at some future meeting of the section.

## Nevada Section Field Meeting

THE fourth annual field meeting of the Nevada Section was held at Comstock on Sept. 23. The section was fortunate in having with it President Dwight, Secretary Sharpless and other distinguished engineers from New York, California and other states who were on their way to the meeting of the Institute in San Francisco. (For description of the day at the Comstock, see page 23.)

The business meeting of the Nevada Section was held in the evening, and the following officers were elected: chairman, R. A. Hardy; vice chairman, J. C. Jones; secretary-treasurer, Henry M. Rives. The executive committee, in addition to the chairman and vice-chairman, includes John G. Kirchen, Emmet D. Boyle, John R. Reigart, W. S. Larsh, George C. Riser, Alex Wise, and S. C. Lind.

The following resolution was unanimously adopted:

Resolved, that the Nevada Section hereby expresses its deep appreciation of the hospitality and generosity of General Bulkeley Wells, Mr. R. A. Hardy and the officers and staff of the United Comstock Mines Co. for the splendid entertainment afforded members of the Institute on the occasion of the fourth annual meeting of the Nevada Section at Comstock, Nev., Sept. 23, 1922.

Ely was selected as the next annual meeting place.

## New York Section Sends Resolution to Secretary Hughes

A RESOLUTION, urging the State Department to abandon its policy of isolation and aloofness from world affairs and to participate immediately in the economic rehabilitation of Europe, was unanimously passed on Oct. 4, by the New York Section of the American Institute of Mining and Metallurgical Engineers, at a meeting at the Machinery Club devoted to a discussion of the Russian question.

Edgar Rickard, Director General of the American Relief Administration, who had just returned from several months in Russia, outlined the work of his administration in feeding ten million people in the famine districts of Russia and told of the renaissance of the people by themselves when unfettered by the communistic government. He carefully refrained from discussing the political situation.

S. Reading Bertron, chairman of the Board of the American-Russian Chamber of Commerce, pointed out the absolute dependence of Europe on the United States to help it out of the economic chaos from which it is impossible to extricate itself. He said:

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The United States went into the war two years too late, because the people of this country did not realize the criticalness of the situation until it was almost too late. The people of this country are unaware today that the economic situation in Europe is almost as critical as the military situation was in 1917 and is fraught with results that in the expenditure of life and treasure may equal those of the Great War. The time has come when the United States can no longer afford to hold aloof from Europe, either on broad humanitarian grounds or on those of personal interest, because the prosperity of the United States depends on the economic rehabilitation of Europe.

Boris Bakhmeteff, a Russian engineer, who was the Russian Ambassador during the Kerensky régime and who, in diplomatic intercourse with both the Wilson and the present administration, is said to have had their entire confidence, who had returned from Russia within 24 hours of his address, said that communism in Russia is dead, that the erstwhile Bolshevik peasants have discovered that the communists' experiment has taken everything from them without giving anything in return. At a recent meeting of the miners in one district, Mr. Bakhmeteff said, where the mining production is one-quarter of one per cent. of normal, the Bolshevik leader began his address by saying, that there was absolutely no way of restoring the production of war in that region without restoring the mines to their proper owners. The Russian people, contrary to the general belief, are not only capable of self-government but are now carrying on the government of 27 separate states in what was the Russian Empire, as well as all of the independent local governments within these states, without administrative direction of the Soviet Government. In fact, the Soviet Government is principally concerned with trying to coördinate these different autonomous states. Mr. Bakhmeteff would not predict the number of months during which the Soviet régime could maintain its tottering hold, but assured his audience that the Soviet Government was about to fall and that Russia would rise a greater nation than ever in her history. This corroborates the statement made by Leslie Urquhart, who recently affected the Russo-Asiatic Consolidated settlement with Leonid Krassin, Soviet Minister of Foreign Trade and Commerce; Mr. Urquhart said that the rapidity of Russia's recovery would astonish the world.

Horace V. Winchell, past president of the Institute, spoke briefly on European conditions, which he has been studying during his several months abroad. His remarks are comprised in his editorial in this issue.

After the addresses, the following resolutions were unanimously passed:

RESOLVED, That it is the sense of the New York Section of the American Institute of Mining and Metallurgical Engineers that the time has arrived when the United States should discontinue its policy of isolation and aloofness from world affairs; and that it should participate in the economic rehabilitation of Europe by aid of counsel, deeds and credits, not only on broad humanitarian grounds but because it seems evident that without this help Europe will continue to be unable to achieve economic stability and without this a sound prosperity in the United States cannot be hoped for.

RESOLVED, That copies of this resolution be sent to the Honorable Charles E. Hughes, Secretary of State, and to the Honorable James W. Wadsworth, Jr., and William R. Calder, United States Senators from New York.

## Limestone and Lime at Boston Meeting

THE 77th meeting of the Boston Section was held on Oct. 2. After the routine business was over, Mr. Hutchinson, the chairman, introduced the speaker of the evening, George B. Wood, president of the Rockland & Rockport Lime Corporation.

Mr. Wood spoke briefly about limestone deposits, and described at length the uses of lime and the different types of kilns and hydrating equipment. He exhibited some excellent lantern slides showing the quarries and plant of the Rockland & Rockport Lime Corpn., including the battery of new Mount kilns recently put in operation.

## Affiliated Student Societies

**New Mexico School of Mines.**—Cooney Mining Club has elected Ward F. Hamm as president and Donald N. Wilson as secretary for the present school year.

**Princeton University.**—Princeton Engineering Society has elected H. A. Manthai as secretary for the current year.

**Ohio State University.**—The Student Branch of the A. I. M. E. met at Lord Hall on Oct. 12, and elected the following officers: president, James C. Johnston; vice-president, John W. Buch; secretary, Foster L. Apple; treasurer, Rodney Stillwell. After the election, Mr. Nold, Mr. McCaughey and Mr. Meuller gave short talks. Plans were made for a smoker for new members and mining freshmen, and for a banquet during the coming quarter.

**Virginia Polytechnic Institute.**—The mining, metallurgical and geology students have organized the Mineral Club, which has been accepted as an affiliated student society of the A. I. M. E. William W. Cormack is president of the Mineral Club and W. S. Palmer is secretary.

## A Soviet Epitaph

NO DOUBT Lenin and Trotsky and others who have had the running of Russia have not been flattered by the comments on their program the past few years. It remained for the Treasury Department, however, to write the epitaph on the Soviet régime in a line worthy of perpetuation for its brevity. In its "Digest of Income Tax Rulings"—not otherwise distinguished for humor or other emotion—a line in the index reads:

"Russian bonds, bank credits and deposits (See bad debts)."—*Wall Street Journal.*

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# Government Papers of Interest to Engineers

## Investigations by the Bureau of Mines*

**Why Miners' Portable Electric Lamps Require Safety Devices** (Serial No. 2371; 9 pages). By L. C. Ilsley.—The Bureau of Mines conducted tests as early as 1911 looking into the safety of miniature electric bulbs. These early tests demonstrated the danger of using miniature bulbs in explosive mine atmospheres unless the current that energized the glowing filament was in some manner interrupted if the glass surrounding the filament should be broken. During 1912, the Bureau conducted a series of tests in which various types of miniature bulbs then on the market were investigated. The first schedule (*Schedule* 5) covering the safety requirements for portable electric miners' lamps was issued in 1913. Subsequent schedules issued for the approval of electric lamps have included a requirement for a safety device, and all approvals have been granted only after the safety device proved repeatedly, by tests, to be satisfactory. Several of these investigations have been reported in *Bulletin* 131.

In spite of the work done and reports published, there arises from time to time doubt as to the necessity of the use of a safety device on a portable electric miner's lamp. In order to review the entire matter and to present some up-to-date evidence on the question, it was decided to make a few additional tests with bulbs such as are being used today on miners' lamps energized with 2-volt lead cells. In 55 tests in which the naked filament was exposed, either at the beginning or after smashing the bulb, 51 ignitions resulted. These tests, although few in number, are convincing, and the Bureau of Mines feels that its policy of requiring a safety device on electric miners' lamps is both wise and necessary.

**Underground Hygiene and Sanitation** (Serial 2391; 11 pages). By R. R. Sayers.—The following phases are considered: (1) Safe practices with drinking water; (2) safe methods of sewage disposal; (3) safe practices in ventilation.

**Ignition of Gas by Electric Detonators** (Serial 2383; 10 pages). By L. C. Isley and A. B. Hooker.—Several ignitions of mine gas, which might have led to explosions, and at least one mine fire attributed to heated leg wires of electric detonators, have occurred at mines in which outside shot firing is practiced. These results having been called to the attention of the electrical section of the Bureau of Mines, the tests reported in this paper were made to determine if possible the cause of the ignitions and to aid in preventing future trouble of this kind.

As a result of this investigation, the following preventive measures are suggested: (1) Connect the detonators in parallel-series, series-parallel, or straight series. (2) Limit the time length of connection to the firing supply to from 0.2 to 0.15 seconds. (3) Use electric detonators with copper leg wires. (4) Use a firing current supply having the lowest standard voltage that will satisfactorily fire all of the detonators as connected. For example, do not fire from a 600-volt circuit if 220 volts would be ample to give at least 2 amperes through every detonator. (5) Use an ungrounded firing circuit.

**The New Albany Shale of Indiana** (Serial 2390; 8 pages). By John R. Reeves.—The first of a series of papers on an investigation of Indiana oil shales conducted by the University of Indiana in coöperation with the United States Bureau of Mines, under the direction of Martin J. Gavin, oil-shale technologist of the Bureau. Gives physical and chemical characteristics of the shale, distribution, amount and nature of products and distillation analyses.

*Reports in full may be obtained from the Director of the Bureau of Mines, Washington, D. C. Give serial number.

# Increase of Membership Department

**Total membership as of Oct. 9, 1922, is 10,242**

APPLICATIONS FOR MEMBERSHIP.—**The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.**

The following persons have been proposed during the period Sept. 15 to Oct. 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

### Members

1—**Julian E. Adler,** Birmingham, Ala.
Present position—1917 to date: Secretary and Treasurer, Corona Coal Co.
Proposers: G. M. Powell, W. E. Leake, H. S. Geismer.

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**2—Edgar Vernon Albert,** Lynch, Ky.
Present position—1915 to date: Superintendent of Mines, United States Coal & Coke Co.
Proposers: E. O'Toole, Howard N. Eavenson, William G. Stratton.

**3—Serge Antoufieff,** New York, N. Y.
Present position: Unemployed.
Proposers: Charles E. Locke, Carle R. Hayward, Edward E. Bugbee.

**4—Gibson Berry,** Round Mountain, Cal.
Present position—1918 to date: General Superintendent, Round Mountain Mining Co. and Fairview Round Mountain Mines Co.
Proposers: Richard H. Ernest, Louis D. Gordon, Fletcher Hamilton.

**5—Warren Scott Blauvelt,** Terre Haute, Ind.
Present position—1920 to date: President, Indiana Coke and Gas Co., and Vigo Mining Co.
Proposers: Samuel A. Taylor, James B. Neale, John V. W. Reynders.

**6—John Stafford Brown,** New York, N. Y.
Present position: Graduate student in Geology, Columbia University.
Proposers: James F. Kemp, R. J. Colony, H. N. Coryell.

**7—Samuel F. Cox,** Wilkinsburg, Pa.
Present position: Chief Engineer, Colorizing Co. of Pittsburgh.
Proposers: Donald P. Smith, W. E. Ruder.

**8—Louis William Greve,** Cleveland, O.
Present position: President, Champion Machine & Forging Co., President, Cleveland Rock Drill Co., Treasurer, Cleveland Pneumatic Tool Co.
Proposers: Benjamin E. Tillson, R. M. Catlin, C. M. Haight.

**9—John Courtney Haddock,** Wilkes-Barre, Pa.
Present position: President, Haddock Mining Co., Haddock Fuel Corpn., and The Haddock Supply Co.
Proposers: Theodore L. Welles, Paul Sterling, A. B. Jessup.

**10—Arthur Livingston Hawkins,** Lewistown, Mont.
Present position: Geologist, Transcontinental Oil Co., Pittsburgh, Pa.
Proposers: Fred W. Stone, H. L. Welsh, Carl H. Loux.

**11—Alexander Charles MacHardy,** Cerro de Pasco, Peru, S. A.
Present position: General Mine Foreman, Cerro de Pasco Copper Corpn.
Proposers: John F. Foran, James L. Head, N. C. Whitten.

**12—Shigeru Matsumura,** Tobata-machi, Fukuoka-ken, Japan.
Present position—1910 to date: Mining Engineer, Meiji Mining Co.
Proposers: Sentaro Higashi, Toshitaka Horiuchi, Heihachi Kamura.

**13—John Matthew Rayburn,** Pittsburgh, Pa.
Present position—1904 to date: Conduct engineering business at House Bldg., specializing in coal mining.
Proposers: Samuel A. Taylor, James R. Elliott, W. E. Fohl.

**14—Gilbert Smith,** Fire Creek, W. Va.
Present position—1921 to date: General Manager, Fire Creek Coal and Coke Co.
Proposers: Ernest M. Merrill, R. H. Morris, W. J. Priestley.

**15—Claude Frederick Southard,** Pittsburgh, Pa.
Present position—1921 to date: President, Southard-Theiss Co.
Proposers: R. C. Crawford, William Affelder, William Archie Weldin, W. H. Beck.

**16—Ferdinand John Wydler-Hollis,** Austria.
Present position: Mine Superintendent, Gewerkschaff-Rathausberg, Bork Wein, Salzburg, Austria.
Proposers: W. S. Holloway, Charles W. Boise, P. K. Horner.

### Associates

**17—Phil M. Conley,** Charleston, W. Va.
Present position—1920 to date: Managing Director, American Constitutional Association.
Proposers: J. K. Anderson, C. E. Krebs, J. M. Clark.

**18—Harry Moss Harrison,** San Antonio, Tex.
Present position: In 1920, leased with option to purchase, San Mateo Mine, Durango, Mexico.
Proposers: J. R. Woodul, L. D. Ratto, G. P. Robinson.

**19—Albert Nogues,** Dilling, Sarre, France.
Present position: Secretary of Direction Commerciale des Forges et Acieries de Dilling.
Proposers: J. Le Bret, F. Ledoux, A. Chastel.

**20—Ching Chou Tang,** Shanghai, China.
Present position: Traveling to China.
Proposers: R. M. Raymond, Robert Peele, Edward F. Kern.

**21—Abraham Harry Tassler,** Hartford, Conn.
Present position: Unemployed.
Proposers: Charles E. Locke, E. S. Dickinson, Carle R. Hayward.

### Junior Associates

**22—Kenneth Paine Corson,** Cornucopia, Ore.
Student, University of Washington.
Proposers: Chris. G. Dobson, Robert M. Betts, Frank Taylor.

**23—John Henry Denny,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**24—Lyman Le Roy Dixon,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, A. Henry Fretz.

**25—Richard Morris Graff,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, H. B. Pulsifer.

**26—Robert T. Hacker,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, H. B. Pulsifer.

**27—Adam Edward Hauck,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, H. B. Pulsifer.

**28—Michael Vincent Healey,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**29—Donald Austin Heath,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, A. Henry Fretz.

**30—Joe McBrian,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**31—Paul McCune,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**32—Felix Zollicoffer Meeks,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, C. L. Dake.

**33—Frederick Snyder Mitman,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, A. Henry Fretz.

**34—Harradon Reets Randall,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, H. B. Pulsifer, A. Henry Fretz.

**35—Ronald S. Rhoades,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, A. Henry Fretz.

**36—Ralph Richmond Ruyle,** Berkeley, Cal.
Student, University of California.
Proposers: W. S. Morley, W. S. Weeks, Lester C. Uren.

**37—Alvin August Claus Schwarzbach,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Howard Eckfeldt, Benjamin L. Miller, A. Henry Fretz.

**38—Norman Edward Sears,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Victor C. Alderson, Lester S. Grant.

**39—Henry Kamsler Shane,** Lawrence, Kansas.
Student, University of Kansas.
Proposers: C. M. Young, R. S. Knappen, Erasmus Haworth.

**40—O. B. Wendeln,** Pittsburgh, Pa.
Student, University of Pittsburgh.
Proposers: Roswell H. Johnson, L. G. Huntley, R. E. Somers

### Change of Status—Associate to Member

**41—Bela Hubbard,** Maracaibo, Venezuela, S. A.
Present position: Geologist, Standard Oil Co. of Venezuela.
Proposers: James F. Kemp, F. G. Lasier, F. W. O'Neil, D. R. Semmes.

### Change of Status—Junior Associate to Member

**42—Frank Stillman Elfred, Jr.,** Baxter Springs, Kansas.
Present position—1920 to date: Mining Engineer, Golden Rod Mining and Smelting Corpn., Cardin, Okla.
Proposers: C. R. Forbes, H. A. Buehler, Charles Y. Clayton.

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**43—Harlowe Hardinge,** New York, N. Y.
Present position: Vice President, Hardinge Co., Inc.
Proposers: R. B. T. Kiliani, Ronald Clark, H. W. Hardinge.

**44—Joseph P. Ruth, Jr.,** Denver, Colo.
Present position—1921 to date: Designing, consulting and building hydrometallurgical plants; at present, operating 50-ton mill owned by Fred Brinker and myself.
Proposers: Horace F. Lunt, A. L. Blomfield, Fred Carroll.

Change of Status—Junior Associate to Associate

**45—Khoren Leon Hussissian,** Madison, Wis.
Present position: Unemployed.
Proposers: S. E. Donnelly, R. McL. Johnson, R. S. McCaffery.

**46—Leopold Nicholas Plein,** Oak Creek, Colo.
Present position: Assistant Engineer, The Moffat Coal Co.
Proposers: Robert M. Perry, Fred G. Jarrett, R. M. Raymond.

## Do You Know Where These Men Are?

NAME — LAST ADDRESS OF RECORD FROM WHICH MAIL HAS BEEN RETURNED

AIKEN, CHARLES WILSON, Production Engr., Stromberg Motor Devices Co., Chicago, Ill.
AINSWORTH, ROBERT E.....General Delivery, Globe, Ariz.
APPLETON, JOHN R., Colorado School of Mines, Golden, Colo.
BAIRD, DAVID BIRCH, Sigma Phi Epsilom House, State College, Pa.
BARCUS, WALTER J. E., Care Hotel Tivold, Panama Canal Zone.
BELL, FRANK R.....Bartlesville, Okla.
BLOCK, JAMES A., Resident Engr., Thacker Fuel Co., New Thacker, W. Va.
BLOW, JOHN J....404 High Holborn, London, W. C., England.
BRADLEY, D. H., JR.....Box 93, Prescott, Ariz.
BRENNON, JOHN C....103 East 84th St., New York, N. Y.
BUNKER, CHARLES E.....Amador City, Cal.
CAMERON, W. H.....358 E. 14th Ave., Columbus, O.
CARNS, Foss D., Arizona Binghamton Copper Co., Stoddard, Ariz.
CHANG, C. L.....370 W. 118th St., New York, N. Y.
CHANG, KO CHI, Carnegie Inst. of Tech., Pittsburgh, Pa.
CHANG, MING-YI. Care Mr. Ting Chun Chang, Peking Hankow Railway Head Office, Peking, China.
CHU, S. Y.....Columbia Univ., New York, N. Y.
CLELAND, GEORGE A....Miazza Woods Bldg., Meriden, Miss.
CROCKER, A. L., 601 North West Bank Bldg., Minneapolis, Minn.
DAVIES, R. G.....2524 Hilgard Ave., Berkeley, Cal.
EVERED, N. J.....Hotel Elliott, Toronto, Ont., Canada.
FERNAU, J. J. C., Hertion Wharf Works, Alferton, Wombley, London, England.
FLETCHER, F. M.....Independence Min. Co., Phelan, Tex.
FRISBIE, HOWARD I.....Race Track, Mont.
GRAY, T. E., Student, Colorado School of Mines, Golden, Colo.
GRIFFITHS, HOWARD B.....Mendenhall, Pa.
GRUBB, EVERETT L.....620 N. Lake St., Madison, Wis.
GUERNSEY, JOHN B.....835 Market St., San Francisco, Cal.
HART, RAY W.....1112 E. 9th St., Tucson, Ariz.
HATFIELD, PERCY W., 3312 Woolworth Bldg., New York, N. Y.
HILL, BENJAMIN F....302 N. 4th St., Cripple Creek, Colo.
HINDSHAW, H. H.....617 Forest Ave., Ann Arbor, Mich.
HOGNASON, GUY B.....Phoenix, Ariz.
HURD, HAROLD W....400 W., Capitol Ave., Springfield, Ill.
HUTCHINSON, RANDOLPH B., 703 Central Bldg., Los Angeles, Cal.
JONES, ALLAN BROWN.....1522 Lafayette St., Denver, Colo.
KRIEGEL, PHILIP, Kelsey Motor Co., Belleville, Newark, N. J.
LAWRENCE, WILLIS.....Mammoth Mines, Mesa, Ariz.
LI, CHU.....Student, Columbia Univ., New York, N. Y.
LIDVALL, EDWARD ROBERT, 159 Pierpont Ave., Salt Lake City, Utah.
LYON, JOHN F., 508 Pacific Finance Bldg., Los Angeles, Cal.
LYONS, CLYDE FRANCIS.....Box 18, Tyrone, N. M.
MCDONALD, JOHN A., 322 Federal Bldg., Salt Lake City, Utah.
MCKENNA, J. P.....Wall Street, Boulder Co., Colo.
MCVEY, EARLE YANCEY, Genl. Supt., Mine Office, Coal Beth Coal Co., Bentree, W. Va.
MAILHOT, CHARLES, C. M. Fassett Co., 209 Wall St., Spokane, Wash.
MARCH, HARRY, Councillor, Midland Institute of Min. Engrs., 17 Victoria St., Westminster, London, S. W., England.
MARSH, LESTER C.....1319 Van Horn Road, Independence, Mo.
MILLS, FRANK S.....Province Lake, N. H.
MORGAN, D. M.....407 W. 4th St., Joplin, Mo.
NICHOLS, CLIFFORD R., Petroleum Midway Oil Corpn., Anaheim, Cal.
NIEMAN, HENRY W.....27 West 44th St., New York, N. Y.
NUGENT, WILLIAM E., Colorado School of Mines, Golden, Colo.
OLSON, VAN CLEAVE A.....Park City, Utah.
O'NEAL, FRANK E., Gouleg Mountain Coal Co., Jodie, W. Va.
PERKINS, H. C., 1701 Connecticut Ave., Washington, D. C.
PONTON, G. M.....Westbrook Hotel, Fort Worth, Tex.
ROBERTSON, FITCH.....Box 326, Metcalf, Ariz.
RODGERS, GEORGE B.....30 E. 21 St., New York, N. Y.
SANDS, W. E.....209 Ocean Front Ave., Venice, Cal.
SCHULER, HERMAN, Director, Agna Amarga Copper Co., Ltd., Vallenar, Chile, South America.
SCHWERIN, MARTIN, Spar Mountain Min. Co., Cave-in-Rock, Ill.
SHERIDAN, L. M., International Nickel Co., Copper Cliff, Ont., Canada.
SIMPSON, GERALD R., Mgr., Simpson Pneumatic Flotation Cell Co., 502 Haas Bldg., Los Angeles, Cal.
SMITH, GEORGE, Dept. of Mines, Sydney, N. S. W., Australia.
STODDART, A. W....1251 St. Andrews Place, Los Angeles, Cal.
SYKES, WILFRED, The Steel & Tube Co. of America, 2111 Conway Bldg., Chicago, Ill.
THOMAS, BRET HARTE, Compania Minera de Penoles, S. A., Mapimi, Estado de Durango, Mexico.
THOMAS W. E. Cia Minerals y Metals, S. A., Apt. 251 Monterrery, N. L., Mexico.
THORPE, O. E.....Sheep Ranch Mine, Sheep Ranch, Cal.
TOLMAN, JOHN D....876 Bidwell St., Vancouver, B. C., Canada.
TSEN, B. C.....Care Mrs. Cindburg, Sewaren, N. J.
TSENG, YIN LIAN.....Blinjoe Banka, Dutch East Indies.
TUCKER, A. W.....Salisbury, N. C.
TURNER, ALBERT A.....Box 517, Iowa Park, Tex.
UDE, G. EDGAR.....Box 933, Morenci, Ariz.
VAUPELL, C. W.....West Dome Oil Co., Wennett, Mont.
WARD, R. J., British Burma Pet. Co., Yenang, Young, Upper Burma.
WATTS, BLYTHE D., Sec., Lynite Laboratories, Cleveland, O.
WONG, YIN CHARLES, 414 W. 118th St., New York, N. Y.
WOO, Y. D., 521 Tompkins Hall, Columbia Univ., New York, N. Y.
YOUTZ, RALPH B., Calumet & Arizona Min. Co., Bisbee, Ariz.
WOO, Y. D., 521 Tompkins Hall, Columbia Univ., New York, N. Y.
YOUTZ, RALPH B., Calumet & Arizona Min. Co., Bisbee, Ariz.
YUAN, P. L., Care Mr. T. L. Yuan, Livingston Hall, Columbia Univ., New York, N. Y.
ZIEGLER, VICTOR, Colorado School of Mines, Golden, Colo.

## On the Haulage Level

Nine Air Haulage men one trip late,
One jumped off a moving train—that left eight.

Eight Air Haulage men over switch eleven,
Motor and four cars left the track, then there were seven.

Seven Air Haulage men using bombs on sticks,
One held his lamp too close, then there were six.

Six Air Haulage men all spry and alive,
One kicked a coupling—then there were five.

Five Air Haulage men all warned before,
One turned over with the Tipple—then there were four.

Four Air Haulage men with good eyes to see,
One paid no heed to blasting signals—then there were three.

Three Air Haulage men, just the right size crew,
One stood too close while taking air—then there were two.

Two Air Haulage men making a record run,
One ran past a red light, now there's only one.

Said one Air Haulage man left all alone,
Now while my skin is whole, and my life my own,
I'll take your Safety Dope Doc, you bet I'll take it straight,
Before I go up the INCLINE with the other eight.

—Adapted by *Safety News*,
Inspiration Consolidated Copper Co.

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# Engineering Societies Library

HARRISON W. CRAVER, Director

The Engineering Societies Library, on the 13th floor of the Engineering Societies Building, 29 West 39th St., New York, contains approximately 150,000 volumes of engineering literature. It is open on week days, excepting holidays, from 9 a.m. to 10 p.m.

The Library offers, on payment for the extra work required, to supply photoprints or translations of articles, make searches for information, prepare lists of references and suggest books on engineering subjects. The cost of searching is $2 an hour. Translations cost $6 and upwards per thousand words. Typewritten copies, $1 a thousand words. Photoprints, 11 by 14 in., cost $0.25.

When the Library contains two copies of a book, one may be borrowed by a member. Transportation costs must be paid by the borrower.

The Library is at the service of every member. Those who cannot visit it may order searches, translations, copies, etc., by mail.

Address correspondence to the Director of the Library, Harrison W. Craver, 29 West 39th St., New York.

**American Fuels.** By Raymond Foss Bacon and W. A. Hamor. First edition. N. Y. and Lond., McGraw-Hill Book Co., Inc., 1922. 2 vol., illus., diagrs., 6 × 9 in., cloth, $12.

The editors have attempted to condense into a series of specially prepared chapters the fruits of the experience of specialists, and thus present an authoritative account of all American fuels of technical importance. It is intended to give informative summaries of sound practice and provide information that will assist the engineer to decide on suitable fuel or changes in order to get the highest efficiency in plant operation.

**Les Axiomes de la Mécanique.** Par Paul Painlevé. Paris, Gauthier-Villars et Cie, 1922. (Les Maîtres de la Pensée Scientifique.) 111 pp., 5 × 7 in., paper.

The axioms of mechanics, as laid down by the founders of the science. From these the author proceeds to a description of the modifications proposed by recent theories. The book, therefore, is not only a thorough study of the fundamental axioms of the subject but also an introduction to the theory of relativity.

**Bearings and Bearing Metals.** First edition, N. Y., Industrial Press; Lond., Machinery Publishing Co., 1921. (Machinery's Dollar Books.) 120 pp., illus., diagrs., 6 × 9 in., paper, $1.

Practical information on plain bearings; various types are shown and their suitability for various purposes explained. Information is also given on the composition and properties of bearing metals, the service to which they are adapted and proper methods of lubrication.

**Coal Trade.** By Sydney A. Hale. Forty-eighth annual edition. N. Y. Estate of F. E. Saward, 1922. 254 pp., 6 × 8 in., cloth, $3.

A statistical and economic review of the coal and coke industry during 1921.

**Conservation of Natural Gas in Kentucky.** By Willard Rouse Jillson. First edition. Louisville, Ky., John P. Morton & Co., 1922. 152 pp., illus., 5 × 8 in., cloth.

Intended to call the attention of those interested in Kentucky to the urgent necessity of conserving the natural gas reserves of the state, and to indicate the necessary steps to prevent waste. Incidentally, the book provides a good summary of the gas resources and industries of Kentucky. It should prove valuable both to producers and consumers of gas.

**Dictionary of Applied Physics.** Edited by Sir Richard Glazebrook. Vol. 2. Electricity. Lond., Macmillan and Co., Ltd., 1922. 1104 pp., illus., 6 × 9 in., cloth, $15.

This second volume contains many articles of importance to electrical engineers and physicists. Some of the longer articles are: Technical Applications of Electrolysis, by A. J. Allmand; Positive Rays, by F. W. Aston; Insulated Electric Cables, by C. J. Beaver; Switchgear, by R. A. R. Bolton; Electrons, by J. A. Crowther; Magnetic and Radio-Frequency Measurements, by D. W. Dye; Molecular Theories of Magnetism, by Kotaro Honda; Stray-Current Electrolysis, by Burton McCollum. Numerous bibliographies and a full index are provided.

**Die-casting.** First edition, N. Y., Industrial Press; Lond., Machinery Publishing Co., 1921 (Machinery's Dollar Books.) 108 pp., illus., diagrs., 6 × 9 in., paper, $1.

Describes briefly the development of die-casting machines, their commercial applications and the alloys used for die-casting.

**Engines and Boilers.** By Thomas T. Eyrie. N. Y., The Macmillan Co., 1922. 234 pp., diagrs., 6 × 9 in., cloth, $3.50.

An elementary course in heat engines for students of engineering, based on the author's experience in teaching engines and boilers and allied subjects at Purdue University.

**Liquid Fuel and Its Apparatus.** By Wm. H. Booth. Second edition. N. Y., E. P. Dutton and Co., 1922. 308 pp., illus., diagrs., 6 × 9 in., cloth. $4.

The object of this book is to present in a handy form the more practical points of the author's larger book, "Fuel and Its Combustion." The present book is fairly closely confined to the use of liquid fuel under boilers and in internal combustion engines. It discusses the principles of liquid fuel and the properties of fuel oils, gives examples of practice in using oil fuel for stationary boilers, locomotives and oil engines, and discusses burners and the storage, distribution and atomising of oil.

**Mastering Power Production.** By Walter N. Polakov. N. Y., Engineering Magazine Co., 1921. 455 pp., plates, diagrs., 6 × 9 in., cloth. $5.

The subject of this volume is the technology of a method of mastering power production so that the best use of our resources will be made under present social, economic and political conditions. The author avoids discussion of the technical subjects already available in books on power engineering, and confines himself to the broader economic, psychological and engineering features. Special attention is given to management problems.

**Materials of Construction.** By H. E. Pulver. First edition. N. Y. and Lond., McGraw-Hill Book Co., 1922. (Engineering education series.) 318 pp., illus., diagrs., 6 × 9 in., cloth. $3.

Prepared primarily for correspondence study in the University of Wisconsin. The ordinary materials, plasters, cements, mortars, concrete, stone, brick, timber and metals, are described and their structural properties explained, in an elementary way.

**Mosquito Eradication.** By W. E. Hardenburg. First edition. N. Y. and Lond., McGraw-Hill Book Co., 1922. 248 pp., illus., 6 × 9 in., cloth. $3.

A concise account of the injury done by mosquitoes, the varieties found in America, the development of control measures and current practice in mosquito control. Directions for organising and administering campaigns are given and information concerning the necessary engineering and other measures of most value.

**New Building Estimators' Handbook.** By William Arthur. 1922 edition. N. Y., U. P. C. Book Co., 1922. 1002 pp., illus., tables, 5 × 7 in., fabrikoid. $6.

This well-known handbook has been revised, and reset in a smaller, though legible type, so that its size has not been increased. For architects, builders, contractors and engineers in estimating the cost of new construction and repairs in all lines of building work, excavating and municipal work.

**Power Alcohol.** By G. W. Monier-Williams. London, Frowde, 1922. (Oxford technical publications.) 323 pp., illus., diagrs., 5 × 8 in., cloth. $7.

A complete, well-balanced account of all the problems—engineering, chemical and economic—associated with the production and utilization of alcohol as a motor fuel.

**Properties of Electrically Conducting Systems.** By Charles A. Kraus. N. Y., Chemical Catalog Co., 1922. (American Chemical Society. Monograph series.) 415 pp., diagrs., 6 × 9 in., cloth. $4.50.

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A comprehensive systematic account of the more important conclusions reached by the study of ionic phenomena, which have hitherto been available only in scattered form, in periodicals and transactions of scientific societies. A convenient summary of the contemporary understanding of the subject, useful both to those directly engaged in studying it and to investigators in allied sciences.

**Railway Electric Traction.** By F. W. Carter. N. Y., Longmans, Green & Co.; Lond., Edward Arnold & Co., 1922. 412 pp., diagrs., 6 × 9 in., cloth. $8.50.

The author attempts to determine what constitutes good practice. The methods of calculation described are for the most part the author's own. The work affords a broad view of the principles underlying electric railways, unencumbered by superfluous descriptive matters.

**Rapports des Ingénieurs des Mines sur la Situation des Mines en 1919 and 1920.** Published by Comité Central des Houillères de France. Paris, 1922. 237 pp., tables, 9 × 11 in., paper.

The two reports that make up this volume give an extended account of coal-mining operations in France during 1919 and 1920. Tables show the output, prices, number of workers, accidents, etc. for the mines in each district.

**Six-place Tables.** N. Y. and Lond., McGraw-Hill Book Co., 1922. 124 pp., 4 × 7 in., fabrikoid. $1.25.

A selection of tables of squares cubes, square roots, cube roots, fifth roots and powers, circumferences and areas of circles, logarithms of numbers, logarithms of trigonometric functions, and natural trigonometric functions.

**Text-book of the Materials of Engineering.** By Herbert F. Moore. Third edition. N. Y. and Lond., McGraw-Hill Book Co., 1922. 315 pp., illus., diagrs., 6 × 9 in., cloth. $3.

A concise presentation of the physical properties of the common materials used in structures and machines, with brief descriptions of their manufacture and fabrication. Elementary in character and intended for use in technical schools in connection with courses in the mechanics of materials. Bibliographies are appended to each chapter. Revised in the light of recent experimental data.

**20th Century Guide for Diesel Operators.** By Julius Rosbloom and Orville R. Sawley. Seattle, Western Technical Book Co., 1922. 637 pp., port., illus., diagrs., 6 × 9 in., cloth.

A summary of present-day knowledge of Diesel engines and their auxiliary machinery, presented in a form suited to the needs of those in charge of power plants. Covers land and sea operation and many commercial types of engines are described. One chapter is devoted to low compression or "semi-Diesel" engines.

**Pennsylvania Bureau of Topographic and Geological Survey.** Mineographed copies of the following papers:

Bulletin 48—Pyrite from Bituminous Coal Mines in Pennsylvania. By Henry Leighton. 19 pp. Written in 1918.

Bulletin 49—Coal Beds in Clarion County, Pa. By J. D. Sisler. 7 pp.

Bulletin 50—Coal Beds in Center, Cameron, Clinton and Lycoming Counties, Pa. By J. D. Sisler. 8 pp.

Bulletin 51—New Oil Pool at Tidioute and Gas Pools near Corry and Meadville, Pa. By M. E. Johnson. 5 pp.

Bulletin 52—Coal Beds in Mercer, Crawford, Venango, Forest, Warren, McKean, Potter, Tioga and Bradford Counties, Pa. By J. D. Sisler. 10 pp.

Bulletin 53—Coal Reserves in Clearfield County, Pa. By John F. Reese. 6 pp.

Bulletin 54—Bituminous Coal Reserves in Pennsylvania. By John F. Reese. 9 pp.

Bulletin 56—Oil Fields Rejuvenated. By Robert B. Bossler. 14 pp.

# Employment Service Bureau

**Under joint management of the national societies of Civil, Mining, Mechanical and Electrical Engineers.**

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

The Employment Service Bureau sends a weekly bulletin, giving lists of positions vacant, to secretaries of local sections and also to secretaries of affiliated student societies.

## Engineers Available

**No person other than a member of one of the four Founder Societies will be registered with the Employment Bureau under this heading.**

**Private Secretary.**—Woman with knowledge of geology, prefers position with geologist or petroleum engineer. IM–1653.

**Chemist and Metallurgist.**—Graduate. Two years in steel laboratory, three years of research in aluminum and non-ferrous alloys. Age 28. IM–1654.

**Mining Executive** desires position as superintendent or manager. Thirteen years broad mining experience. Technical graduate. Speaks Spanish. Ten years with present company in Mexico. IM–1655.

**Mining Engineer** with a coal company. Nine years in Iowa coal fields. Age 37. IM–1656.

**Mining Engineer.**—Graduate. Competent to hold position as assistant manager, mill superintendent, or chief engineer. Varied mining experience in gold, silver, and iron, in Canada, Newfoundland, and Mexico. Speaks Spanish. San Francisco or Los Angeles interview. Age 32. Unmarried. IM–1657.

**C.I.T. Metallurgist.**—Four years practical experience while securing money to complete education. Three years experience since graduation. Desires definite opening in operating or sales end of growing organization. Age 26. Married. IM–1658.

**Mining Engineer.**—Desires executive or technical position. Eleven years in Lake Superior iron mines, covering surveying, mapping, sampling, office methods, shaft sinking, exploration, development, and methods of mining both large and small orebodies. Familiar with power scraping and branch raising. IM–1659.

**Mining Engineer.**—Graduate. Fourteen years in Egypt, Canada, Peru, as chemist, engineer, manager. Development and operation. Speaks Spanish, French and Arabic. Now with large copper mining company in South America. Available Jan. 1. IM–1660.

**Mining Engineer.**—Graduate. Experience as highway draftsman one year; topographic surveying six months. Desires change to chemistry, assaying, or general mill work. Speaks Spanish. Single. IM–1661.

**Executive Mining Engineer.**—Five years in railroad location construction and general construction; three years in mine sur-

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veying, assaying and mining; twelve years in developing, equipping and managing mines. Age 40. Married. IM-1662.

**Superintendent or Manager.**—Ten years experience, practical foundation as well as technical graduate. Opportunity principal consideration. Age 33. Available 30 days notice. IM-1663.

**Metallurgical Engineer.**—Broad experience in heat treatment of iron and steel; also ferrous and non-ferrous alloys. Successful research record. Business experience. Open for technical or commercial position offering opportunities. IM-1664.

**Engineer.**—Twelve years experience as draftsman, designer, and engineer of centrifugal pumps, mine hoists (ball-bearing and plain-bearing types), general mining equipment and sales of same. Desires position as designer or assistant to chief engineer for a medium size concern manufacturing this type of equipment. Will go anywhere but prefers southwestern section. IM-1665

**Mining Engineer and Superintendent.**—Many years in metal-mine operation and examination, particularly study of method of ore deposition and directing development in consequence. Southwest preferred. IM-1666.

**Mining Engineer.**—Graduate. Desires position as assistant with high-class consulting engineer, or with large company. conducting exploration work. Three years as assayer, mine engineer, geologist, mine accountant and assistant superintendent. Mine mapping and drafting a specialty. Age 25. Single. IM-1667.

## Positions Open

**Persons applying for any of the following positions will please place their names, addresses and initials of the society to which they belong (A. S. C. E., A. I. M. E., A. S. M. E. or A. I. E. E.) on the outside of the envelopes containing the applications.**

**Junior Mining Engineers,** or men of broader experience. Apply by letter. Nevada. V-2452.

**Construction Engineer** specializing in line of oil mills for extracting oil from olive husks by means of solvents, including installation of soap plant, complete refinery (neutralization, deodorization and decoloring). Apply by letter. Mahdia, Tunis. V-2458.

**Sales Executive** for established firm of engineers and constructors in New York. Man of character and standing, with wide acquaintance among business men and talent and personality for sales. Apply by letter giving full information. New York City. V-2510.

**Sales Representatives** for gas and oil-burning equipment in United States. Apply by letter. V-2513.

**Sales Engineer** to sell crushing and grinding machinery. New York City. V-2522.

**Draftsman** for chemical plant. Knowledge of piping, structural work and plant layout desirable. New York City. V-2527.

**Laboratory Man** experienced in testing concrete briquettes. Transportation paid. New York City. Alabama. V-2543.

**Chemical Engineer** who has actual experience in production of flowers of sulfur from the crude. Contemplate erecting a plant for refining of sulfur. Wish to secure some information regarding cost of construction of such a plant and approximate cost of operation. If plant is erected, will allow equal share of profits. Apply by letter. California. V-2545.

**Mining Engineer** for sales engineer experience in cyanide-mill work. Apply by letter. New York City. V-2552.

**Mining Engineer,** recent graduate for work in gold mine in South America. Apply by letter stating age, education and experience. V-2564.

**Sales Engineer** for chemical machinery. Some knowledge of chemistry required, and some experience. 25–30 years old. Apply by letter. New York City. V-2574.

**Mining Engineer** familiar with mining of silica in all branches; to check report on property, purchase, install and operate equipment, etc. V-2590.

**Engineer** to sell oil-storage and oil-burning equipment in Northeastern territory. General industrial plant experience and preferably sales experience. Apply by letter. Age 30–35. New York City. V-2596.

**Tunnel Engineer,** R. R. Location not stated. V-2605.

**Engineer** experienced in steel to take charge of quality tests on steel. Prefer man of general experience in testing and judging steel, rather than one too highly specialized in one line. Young man preferred. New York City. V-2617.

**Sales Engineers** and junior engineers to sell fuel-oil burners and oil-burning systems. Brooklyn and Long Island. V-2628.

**Engineer** experienced in road building and handling of crushed stone, to investigate market in Illinois with view to opening a line quarry. Apply by letter. V-2611.

**Chief Draftsman** to take charge of drafting office. Must speak Spanish. Apply by letter. South America. V-2621.

**Engineer** to write articles dealing with economic, political, and social problems of the day, that will interest intelligent people of all classes and secure attention of engineers, business men, educators and statesmen. Apply by letter. Pennsylvania. V-2634.

**Engineers** to gather information needed in different branches of engineering and to put it in most concise form for publication. Apply by letter. Pennsylvania. V-2635.

**Coal Mining Engineer,** 35–45 years old. Some technica education and a number of years practical experience in operation of surface and underground mechanical equipment in mines of anthracite fields. Apply by letter giving age, education, experience and salary desired. New York City. V-2651.

**Structural Draftsman.** New York City. Apply by letter. V-2654.

**Mine Blacksmith** at feldspar quarry to sharpen jack-hammer steel. Apply by letter. Connecticut. V-2662.

**Plater** experienced in continuous process of coating fine wire Must have sufficient knowledge of chemistry to make own formulas. If applicant has executive experience there is an opportunity to become interested in the business. Apply by letter. Massachusetts. V-2670.

**Chemist** familiar with steel analysis to handle routine work in connection with plant in a new laboratory. Young man with good technical training, honest and industrious, able to get along with men and quickly find his place in a busy organization. Steels comprise all high-grade steels used in automobile construction, as well as tool steels. Some occasional work on non-ferrous alloys, paints, gasoline and oil, and rubber. Apply by letter giving full particulars, when available and salary desired. Pennsylvania. V-2695.

**Practical Jig Operators.**—Single men preferred. Apply by letter. Illinois. V-2696.

**Sales Engineer.**—Technical graduate, two to four years out of college. Some sales experience preferred. Knowledge of gray-iron casting business would be advantage. An out of the ordinary proposition. Apply by letter. New York State. V-2697.

**Instructor Ore-dressing and Metallurgy.**—Man in early thirties with good balance of technical training and professional experience. Previous teaching experience unnecessary if personality is good. V-2704.

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# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

## Powdered Coal for Copper Refining

A TEST of powdered coal versus hand-firing was recently made at the copper-refining plant of Société Anonyme des Mines et Fonderies de Pontgibaud, in France. This company operates four blister furnaces of 7½ tons capacity, which heretofore have been hand-fired. One of these furnaces was fitted up for powdered coal firing and tests were conducted to determine relative production and costs. The results showed a saving of 30 per cent. in fuel used and a 25 per cent. decrease in the time required per heat.

Comparative results of the two methods of firing were as follows:

| | Hand Fired | Powdered Coal Fired |
|---|---|---|
| Amount of copper refined per heat in 1 furnace | 16,500 lb. | 16,534 lb. |
| Total time required per heat | 24 hr. | 17¾ hr. |
| Total coal consumed per heat | 5,300 lb. | 3,682 lb. |

No difficulty was experienced in the powdered coal operation and the refined product was reported to be of as good quality as that of the hand-fired equipment.

The series of tests covered a period of several weeks and an examination of the furnace at the conclusion showed the entire furnace to be in first class condition, and the linings in no way damaged by the new method of firing.

The powdered coal furnace used was designed by Quigley Fuel Systems, Inc., of New York, and the tests were conducted with the coöperation of their resident engineer in France.

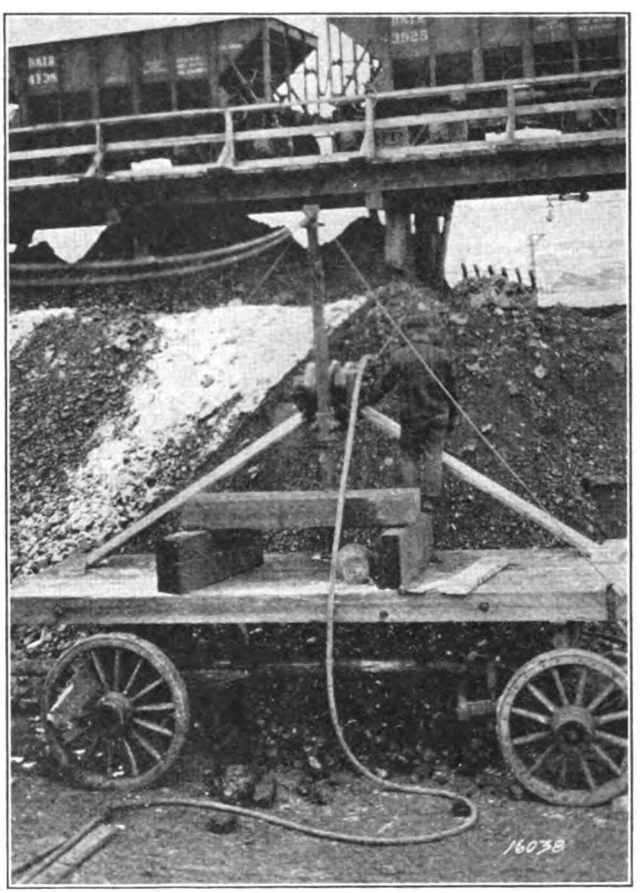
## Tools With Rubber Handles

BY THE "Rimco" insulation process, of the Rubber Insulated Metals Corpn., 50 Church St., New York, rubber is bonded to metal on the handles of pliers, screw drivers, switches, etc. This not only adds to the safety of workers in electrical fields, but is an advantage even where insulation is not necessary, as the softer material is easier to handle than the hard metal.

## Mechanical Methods Applied to Grading Coal Piles

ONE of the large iron-mining companies in the Lake Superior District was fortunate in finding available a year's supply of coal. In piling the coal, it was decided to use an Ingersoll-Rand 6H Little Tugger hoist with a drag scraper for grading.

The machine shown in the photograph is a small, compact, double-drum hoist which develops 7 to 8½ hp. on 60 to 80 lb. air pressure. One of the drums is called the haulage drum and the other the tail-rope drum. When one drum is engaged, the other runs free. The haulage rope is lead from the drum directly to the front of the scraper. The tail rope is lead from the drum to a snatch block or sheave mounted conveniently behind the coal pile, and is attached to the back of the scraper by a clevis.



ONE MAN WITH LITTLE TUGGER HOIST DOING THE WORK OF TWELVE ON GRADING COAL PILE.

One man can operate the scraper in both its forward and backward motions, therefore one man with a 6H Little Tugger hoist replaces the 12 men required to do the grading by hand.

## Varied Uses of Dings Magnetic Separator

THE Dings magnetic separator is finding an increased use in both standard and special applications. At the Owens Bottle Co., Charleston, West Va., 12 to 15 lb. of iron are removed from every 18 tons of glass batch to insure better glass product. At the Worthington Pump Corpn., at Cudahy, a machine used on separating shake-out sand in the iron foundry recovered enough iron in six months to pay for the machine. The sand was used again for molds.

It is used in separating roasted pyrites from zinc blende at National Zinc Separating Co., Platteville, Wis., where the

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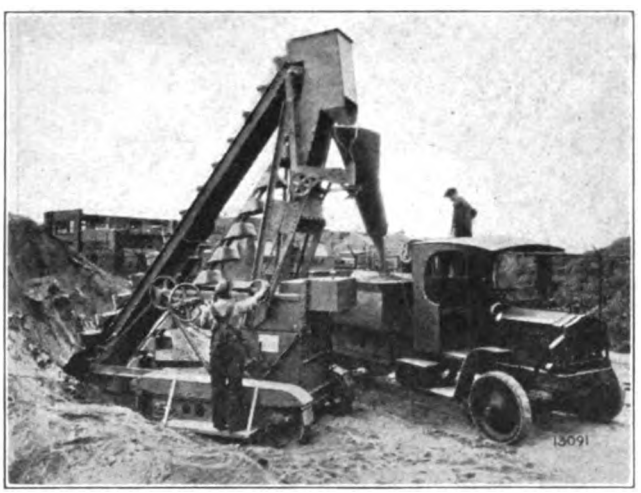
machine handles 2000 lb. per hour. Average of 5000 tons produced a 62 per cent. zinc product. Loss in tails is only 1.5 to 2 per cent. zinc.

Enormous quantities of borings and skimmings pass over these separators daily at the Michigan Smelting and Refining Co. plant; 12 machines have been installed here in 11 years. Bronze castings for high-pressure valves must be free of iron. Hence a Dings installation is used in the Lunkenheimer Co. plant, Cincinnati, Ohio.

## Modern Portable Loaders

THE latest type of Jeffrey portable bucket loader is called the Tanktred. The buckets used on this loader are of heavy malleable iron and have a steel cutting edge extending well around the ends of the buckets, which protects the buckets from wear and is itself renewable. The bucket is designed so that the digging edge has a cutting clearance at all points and the foot



JEFFREY PORTABLE LOADER AT WORK.

of the elevator is constructed so that the buckets are wider than any other part; therefore the whole machine can be advanced several feet into the pile with nothing but the clean cutting edge of the buckets coming in contact with the material.

Another distinctive feature of this loader is a relatively large foot wheel, which, by reducing the centrifugal force, enables the buckets to pick up the material and especially the large lumps without kicking them away. A flexible wood boom keeps the buckets digging, but will spring enough to release the buckets from overload strain when they encounter a cave-in or such an obstruction as a railroad tie.

Two speeds, a traveling speed for moving the machine from place to place, and a feeding speed for driving the machine directly into the pile, give a wide flexibility of operation.

The machine is equipped with either gas or electric power.

One man only is required to operate the loader, and can readily manage his machine so that the buckets are always full.

A universal swivel spout enables the operator to spot the material in various portions of the truck with little change of position of either the truck or the loader.

In order to increase the capacity of loading machines by keeping the elevator at work while a full truck is being pulled away and an empty one driven into place, storage hoppers have been developed. These hoppers are sometimes made with adjustable sides so as to correctly measure material for a batch for concrete mixing machines.

## Industrial Notes

**Pennsylvania Crusher Co.** has appointed J. B. Clark, Jr. one of its sales engineers. He will make his headquarters at the company's New York Office, 50 Church St. Mr. Clark has been associated with the Koppers Company of Pittsburgh in the erection and operation of by-product coke plants, including the Seaboard plant at Jersey City. He will give particular attention to engineering coöperation in connection with the installation of the Pennsylvania company's coal preparation machinery.

**F. S. Pearson Engineering Corpn.**, Fisk Bldg., 57th St. and Broadway, New York City, has reëstablished its department for industrial management and technical auditing of industries and public utilities.

**H. H. Robertson Co.**, Pittsburgh, Pa., has appointed Johns-Manville Inc. as joint selling agents. All asbestos-protected metal (recently called Robertson Process Metal) roofing, siding, accessories and ventilators will be manufactured and shipped from the plant of H. H. Robertson Co. at Ambridge, near Pittsburgh, Pa. In the manufacture of asbestos-protected metal products by H. H. Robertson Co. the Johns-Manville asbestos saturated felts will be used.

**William A. Hughes** announces the opening of his office at 26 Cortlandt St., New York, for the practice of patent law dealing with electricity, chemistry, electrochemistry, metallurgy, etc. He is a member of the bar of the District of Columbia, and has been one of the examining corps of the U. S. Patent Office.

## Trade Catalogs

**Sandvik Steel Inc.**, Conveyor Dept., New York.—Catalog 18-T, on Steel Belt Conveyors. Numerous illustrations showing the conveyors in use.

**Century Wood Preserving Co.**, Pittsburgh, Pa.—Bulletin 24 on Treated Ties and Timbers for Industrial Plants. Describes methods of treating the timber, as well as the use of the finished products.

**National Iron Co.**, Duluth, Minn.—Booklet describing and illustrating the Hoar Underground Shovel, for loading ore, coal, dirt or rock. Gives construction details and methods of operation, also specifications.

**De Laval Steam Turbine Co.**, Trenton, N. J.—Catalog C, on Velocity Stage Turbines, explaining and illustrating in detail the ways in which these turbines satisfy modern requirements.

**Warren-Knight Co.**, 136 N. 12th St., Philadelphia, Pa.—Booklet on "Sterling" Transits and Levels, giving detailed specifications.

**Colorado Iron Works Co.**, Denver, Colo.—Catalog 32-B, on the Drying of Fine Materials with a description of the Lowden Patent Dryer. This booklet deals with the drying of extremely fine materials which form a sticky mass when wet, and which have a tendency to dusting when dry.

**Effects of Certain Inhomogeneities in Alloys.**—An investigation being undertaken at the Ithaca, N. Y., field office of the U. S. Bureau of Mines has as its object the obtaining of data on the effect of different types of inhomogeneities in various alloys, especially in regard to resistance to repeated bending, for comparison with the effect of non-metallic inclusions in steel. Lead in brass and copper oxide in copper are to be studied. The work has been assigned to Dr. H. W. Gillett, chief alloy chemist, and E. L. Mack, assistant alloy chemist.

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# MINING AND METALLURGY

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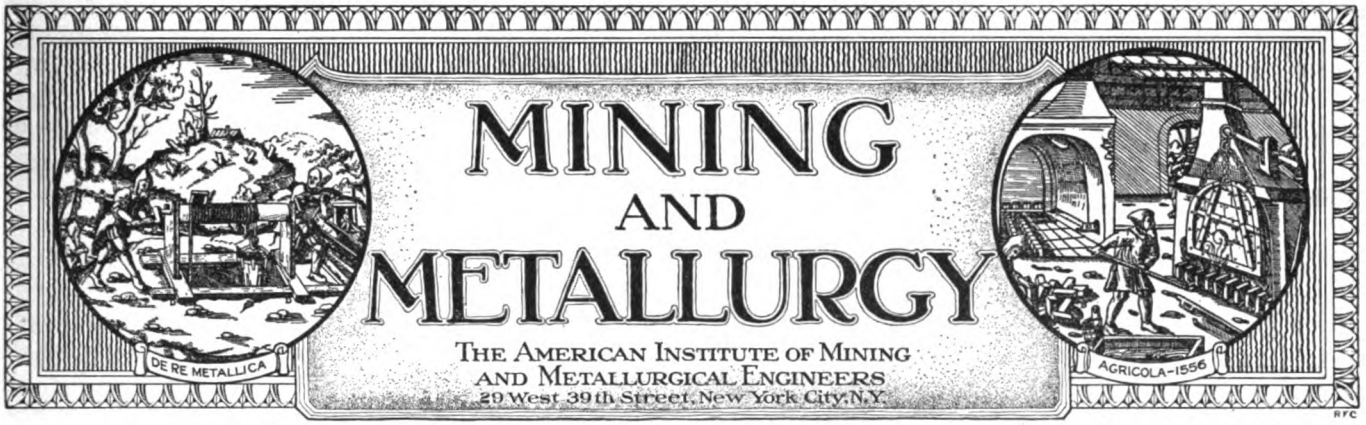


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## EDITORIAL

### Economics and Politics

ECONOMICS and politics are so closely associated that often it is impossible to discriminate between them. Thus, we must consider the recent election, which resulted in an upset for the administration. Toward this there were many contributory factors, but beyond any doubt the big element was widespread dissatisfaction with present economic conditions, particularly in the western agricultural states.

Early in the year the administration began to promote the idea of the early advent of prosperity, having the November election in view. During the period of the coal and railway strikes, it behaved pusillanimously rather than courageously face the issue in behalf of all of the people. In the fall, it had the effrontery to declare that prosperity had come.

On election day the people pronounced all of this to have been buncombe. A prosperous and contented people want to preserve the administration that has steered things successfully for them. In the last election, the people said collectively that they were not prosperous and happy and did not believe the politicians who had been trying to give them a faith cure.

The result has been a great strengthening in Congress of what is called the progressive party in contradistinction to the conservative or reactionary. In truth, these names do not mean any more than that the progressives would like to progress to good times while the conservatives would like to regress toward them. Neither element has any real principles and both are about equally nonsensical in their ideas as to panaceas. One party thinks of such things as ship subsidies and high tariffs while the other contemplates such things as governmental credits and it is to be feared dwells rather fondly upon thoughts of cheap money. Through the councils of both parties run notions of class legislation, the ideas of doing something favorable for this class or that with the hope of relieving its particular troubles, regardless of the certainty that such reliefs will be



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increased distresses of other classes. There is no consideration of the welfare of the people as a whole, no clear thinking, no courage, no leadership.

The present state of mind of the people of the United States has been compared to that of a herd of cattle in a corral, charging blindly to and fro in the hope of finding some way out. Nobody knows whether there is going to be any way out, short of the direness of times so hard that they will break down all artificialities, but if there be any way out it will be found only by the leader who can rise above all sectional and class considerations and can persuade the people to conform to the principles of sound economics irrespective of whether they be palatable or not. Not until we have learned collectively to earn a living without working or to make something out of nothing are we going to get anywhere with ship subsidies, soldier bonuses, excess profits taxes, governmental interference in industry, state and municipal extravagances, etc. The only way out of our troubles is going to be recognition of the stern facts and then hard work and thrift. Recognition of the stern facts implies a remembrance that the civilized world has had four years of war and four years of its aftermath and that during those periods it suffered losses and dislocations that are not going to be altered by assuming that they never happened, or that they created a new world (meaning a pleasanter one) or a new freedom, or any such nonsense.

W. R. Ingalls.

## Averting the Next Coal Strike

AT THE present time, all those who are interested in the American mining industry can render a great service to it. We are now faced with certain grave difficulties in the near future. We have had, from April 1 to Sept. 1, a strike of the coal miners which has been of such an extent and has shown such a compact organization on the part of the United Mine Workers of America as to cause the President of the United States to state publicly that the United States was at the mercy of the United Mine Workers of America. This is an extraordinarily serious statement to have been made by one in the position of President Harding, and it behooves us who are interested in the mining industry to see if that statement is true and if it is true why it cannot be changed; because if I size up the American people aright, they are not going to be, or are going to remain, at the mercy of any small body of men who can threaten their welfare, who can make them suffer without any reason on their part, or who by the mere edict of a small minority can dictate to them what they shall do in a given case.

The answer to the question "Who are the coal miners?" that has been given by some of the United Mine Workers is not altogether correct, as I see the situation. It seems to me that the coal miners are the adventurous men of some twenty-seven nationalities working in our mines. These men have one fundamental desire and that is to have a job. Their next desire is to have a better job and it seems to me that by organizing, by adopting or promoting plans of coöperation between the employer and the coal miner, we can give him first his fundamental desire, which is a job, and we can allow him as he shows his ability to achieve the chance to get a better job.

If we do not, between now and next April, arrive at some plan by which the employee and the employer in the coal mines can coöperate, probably we shall again have to go through the agony of a strike, as we have done this past summer. I think we all can help in this serious situation by creating a proper sentiment and promoting a proper discussion of the best way of achieving such coöperation.

Sidney J. Jennings.

## The Shortage of Labor

FROM all quarters, there have been during recent months reports of shortage of labor, and owing thereto it became necessary for a good many industrial concerns to raise wages. Respecting this there can not possibly be any illusion. Manufacturers raise wages in order to secure the labor that they need and they would not take this step unless it were necessary.

As for the reason, however, why there should be a shortage of labor, there may be a good deal of illusion. The commonest explanation is the curtailment of immigration that became effective under a new law a little more than a year ago. Before jumping to conclusions about this, it is well to examine the statistics. The latter show that the net increase of population by arrival and departure of aliens was about 87,000 in the fiscal year ending June 30, 1922. That is indeed a low rate, but it was much lower in the fiscal years ending June 30, 1919, 1918 and 1915. In the fiscal year ending June 30, 1921, the net gain was 552,000, which was not very different from the average rate in prewar years.

The great addition to our labor supply is derived from the natural increase in our own population. From 1913 to 1922 the gain has probably been about 12 per cent. and the increase in the number of workers available has doubtless been substantially in correspondence therewith. Now if we shut our eyes to the misleading comparisons of the present rate of production, and business in general, with corresponding months in 1921 (which was an unusually bad year) we shall find that the general rate of physical production, manufacture of goods, railway traffic and employment of labor in the United States is just rising to the rate of 1913, having been below that rate during the major part of the first three quarters of 1922, and this is the fact notwithstanding the increase in population which naturally demands more goods and service.

These representations do not support the idea of

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curtailment of immigration during the last year being mainly responsible for the shortage of labor. Nor does such a surmise conform to the known facts that a large part of the personnel of the coal-mining industry (which is notoriously overmanned) was able to remain idle for about five months of this year, while a large part of the textile workers of New England were idle for about eight months, without experiencing any serious hardships. Anyhow, the newspapers were conspicuously free from reports of soup kitchens, etc. during that time.

Without any doubt the curtailment of immigration has deprived us of some of the hewers of wood and drawers of water and diggers of ditches whom we should like to have, but I find the explanation of the shortage of labor rather in the unbalanced state of industry and the maldistribution of national produce, which enables large classes of workers to profit at the expense of other classes and enjoy among other things the luxuries of leisure and the refusal to do disagreeable work. It is to be pointed out that since the beginning of rising prices and wages, in 1915, nearly eight years have passed during which many of our old workers have become superannuated, their places having been taken by the new generation which has known nothing but soft times and resists the pressure forcing them into work that they do not like. Moreover, an increased number of workers are commanded by federal, state and municipal governments, which obtain their funds through taxes that are still increasing in the aggregate, notwithstanding the praiseworthy efforts of the federal government to retrench. It is conceivable, of course, that the governments could appropriate a large part of the national produce through taxes, expend it for the building of pyramids, as they used to do in Egypt, and create a terrific shortage of labor for other purposes.

This subject is too immense to be treated comprehensively in a brief editorial, but I should look for the causes for the shortage of labor in these fundamental things rather than in one year's curtailment of immigration, which seems to me to be too small a matter to play a very important part in the great picture. This is not to say, of course, that I am not in favor of liberalizing the immigration law.

W. R. INGALLS.

## A New Method of Testing Hoisting Ropes

BEFORE the war, the New Jersey Zinc Co. had inaugurated steps to devise a new method for the investigation and testing of hoisting ropes in place without the destruction of the rope. The war put an end to this investigation, which is now being revived on a much larger and more pretentious scale.

The United States Bureau of Mines and the Bureau of Standards have been interested and both strongly endorsed the need of such an investigation. Some of this work would be directly in line with work already done by the Bureau of Standards, which would be particularly well fitted to undertake this new investigation. In order to avoid the destructive effects upon the rope of tests made upon it by present methods, it is believed that the application of magnetic surveys of the conditions of the wires or the use of radio frequency waves are possible.

Herbert Hoover has been interested in this matter and has sent to the Director of Budgets a request for an appropriation of $20,000 to be expended during the next year on this wire hoisting-rope research. The benefits accruing from this work will be not only of great importance to the mining industry, but will be of equally great value to the public in view of the numerous applications of steel hoisting ropes to elevator service and construction work.

The study of this subject has been divided into three fields: first, the usual investigations of current good practice; second, testing laboratory investigations; and third, research in new fields which it is hoped will develop methods along the lines of those suggested or others which will result in a decided step forward, and in effect permit the inspector to see into the rope and determine all conditions and factors there which affect the factor of safety.

This movement has the support not only of Mr. Hoover and the Bureau of Mines and the Bureau of Standards, but of all the prominent mining companies thus far approached, and many of these latter have taken the matter up with their senators and representatives, showing the need for such progress. Memorials to this effect have also been passed by several local sections of the Institute. It will take the united support of the mining profession to get even this small sum of $20,000 appropriated for this purpose, but the need for investigation is so great and the beneficial results would be so far reaching and would result in the protecting, and the saving, of so many lives that it justifies both the effort and the expenditure.

BENJAMIN F. TILLSON.

## Interchange of Technical Data

THE annual report of the Broken Hill South Limited for the year ending June 30, 1922, contains under the sub-heading "Technical Papers by Staff" the following interesting paragraph:

> During the past year various members of the staff have contributed papers to the Australian Institute of Mining and Metallurgy, descriptive of South Mine plant, practice and research. These form a valuable addition to the technical literature on such subjects.

The company may well take pride in the work of its technical staff in contributing to the literature of the profession. Most companies in this country are liberal in this respect, at least so far as permitting their staff to write. It would inure to the advantage of the staff, the company and the profession if these companies besides permitting these contributions would stimulate them.

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# Review of the Month

AT THE beginning of November, Mussolini had firmly established himself at the head of the Italian Government. He himself referred to the ascendancy of the Fascisti as the result of a revolution and bluntly informed Parliament that it was to vote, as a matter of form, as he ordered, or else be dissolved. One of the great consequences of these events in Italy was the impetus that they gave to similar movements in other countries of Continental Europe.

Another great event of the month in world affairs was the repudiation by the Turks of the Mudania agreement and their notification to the Allies that the latter must evacuate Constantinople and allow the Dardanelles to be closed. This had the effect of once more consolidating Great Britain, France and Italy in so far as this question is concerned, and there was prompt refusal to accede to the demands of the Turks.

With the advent of November, both the United States and Great Britain were in the throes of political contests. The result of the American election was a landslide against the administration and especially was it an expression of agrarian discontent and a declaration in effect that our domestic affairs are not good in spite of political representations that they are.

In Great Britain, the Conservatives were put in power by a substantial majority in Parliament, but the fact that the Labor party became numerically the second party instead of the Liberals and that it polled about 40 per cent. of the total popular vote affords ground for misgivings, especially when it be considered that the Labor party was standing on distinctly socialistic and communistic principles.

In Russia, there was a sitting of the Third Internationale, to which Lenin in a speech made a quasi-confession of the failure of the communistic experiment in Russia. He admitted, moreover, that Russia could not industrially reconstruct herself without capitalistic help. Nationally the country is making progress. During November, the Far Eastern Republic surrendered to the Soviet, which thus carried Russia back to the shore of the Pacific.

In Germany, the ministry of Doctor Wirth fell, owing to the withdrawal of socialistic support. A new ministry was formed under Dr. Wilhelm Cuno, an important man of business, who should be able to give Germany the kind of administration that is needful, but it is questionable whether the socialistic parties will permit anything very effective being done.

Soon after the middle of November, representatives of most of the powers, including the United States, assembled at Lausanne, in Switzerland, to arrange things with the Turks. This assumed the character of a meeting for writing a peace treaty, the Turks having repudiated the treaty of Sèvres. Four years ago they were vanquished, but they presented themselves at Lausanne in the guise of victors, or what looked very much like it.

The Supreme Court of the United States rendered a decision in the Pennsylvania anthracite taxation case to the effect that states may lawfully impose taxes upon commodities produced within their borders before such commodities enter into interstate commerce and notwithstanding that other states are large consumers of such commodities and do not produce them.

The production of bituminous coal increased rapidly and probably the accumulation of surplus stocks is beginning again. The output of anthracite coal is not making good the deficiency resulting from the long idleness but by virtue of good administration the supply is being eked out.

The stock market experienced a major decline, running through the greater part of November, the lowest figures being recorded near the end of the month. This was probably in major degree the consequence of over-speculation, but it is now clear that the secondary boom that was expected right after the ending of the coal strikes is not going to materialize. However, the Government is obligated to pay off the war savings stamps at the end of this year. These are largely held by small investors who intend to spend the proceeds of their liquidation and we may therefore expect a spurt in retail trade soon after the turn of the year.

In the metal markets, iron and steel became distinctly easier. During November, copper stiffened a little and then relapsed a little. The steadily increasing production of Chile overshadows this market. Zinc rose to about 7⅜ c. on European buying, which aggregated about 15,000 tons, and reflected a real shortage of supplies on the other side. Upon satisfaction of this demand it appeared that domestic demand was not very good. Galvanizers probably overbought themselves on the rise. Consequently, the price of spelter declined rapidly to about 6.80 c., but later it rallied to 7 c. Lead was consistently strong, and toward the end of the month the large producers raised their price for contracts to 7.10 c. During the month the price for prompt and early deliveries was steadily from ⅛ to ¼ c. above the contract price. Continued large demand for lead, especially for storage batteries, with not very much increase in the production is the explanation of the strength in this metal, which has a sound economic foundation.

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# Reward of Loyalty and Labor

By CHARLES M. SCHWAB

Chairman, Bethlehem Steel Corporation

WHEN I leave this life, as an employer of labor there is no one thing that I want so much to be engraven upon my monument as the fact that I have been one of the men who have worked, whether with my brains or my hands, for the advancement of industry in the United States, and to be regarded, as I should like to be regarded by labor with love and kindly remembrance for our years of association.

In my relationship with my employees, I have always contended that every man should be paid for what he does. I will not employ or be associated with any kind of labor of which the organization insists that a man shall receive a fixed sum of money for his day's wages, however poor or good his day's labor may be.

What applies to the common laborer applies equally well to the management, the brains of an industrial establishment. I have always thought of industry as a three-legged stool, with capital, management and labor as the legs. All three legs of that stool must be there before that stool can stand up. If you take any one of those legs away, it is going to topple over. The three must stand together for successful business accomplishment.

I believe that a man who has his labor to sell, to put it plainly, has just as good a right to bargain for the best price for that labor as those who employ him. It is a perfect right for him to do so.

If the government of our United States is right, our method of handling labor in our Bethlehem plants is right because it is representative and democratic.

We have our labor elect delegates; elect representatives from their own ranks, who shall meet frequently. That constitutes, as it were, the House of our great Congress in Washington, the industrial house. We have our management, who represent the Senate, who meet independently. Working men have learned to express their views freely as to whether they are treated fairly and whether conditions are right or wrong.

My experience has shown that the real autocrat in the labor situation is the subforeman, the man who comes immediately in touch with labor. He is usually a man who has been a laborer, promoted to the position, and when promoted he becomes a real autocrat and treats labor as labor ought not to be treated. If he does not like men, he fires them. If the condition is not good and a man complains to his superior, this subforeman fires him because he has complained to the superior. The result is that these working men in years gone by have been in the position where they could not make known matters which the general management of the works would have been glad to correct.

Our system has taught working men to express freely their views as to what is right and what is wrong as to conditions, and it has taught the subforeman to realize that he is not an autocrat. We have gone along in this way for 10 years. The hardest difficulty to iron out is reduction of wages, and yet during this past depression we, at Bethlehem, have been obliged to reduce the wages of our great army of working men three successive times, and not a note of complaint was received from any workman when the reduction of wages was made. We frankly gave them our statement of affairs. We told them our profits and losses. We made them partners with us in the business, and they felt the necessity. We appealed to their reason, and they were content and happy.

## Loyalty Must be Won by Fair Treatment

You cannot hire loyalty. You cannot hire love of employment. It must be implanted in the system, it must be implanted in the heart and mind of the working man. If you cannot implant it there by kindness and fair treatment, you will never implant it at all. If you have a group of working men or a group of management that has not this love and loyalty to the firm, you will have a firm that sooner or later will be in the courts of bankruptcy in this country.

I apply this same principle to the management. The employees of the Bethlehem concern are as highly paid as any employees in the world, not because of the efforts of other people or the success of their firm, but because of their individual efforts. The manager of a department of the Bethlehem company gets a proportion of what he makes or saves for his own. It is a liberal proportion, and it is a proportion that increases with the amount that he saves. In other words, if a superintendent makes pig iron for $1 a ton he does not get anything, because any manager can do that. If he makes it for 95 c., he gets 5 per cent. of the saving for himself; if he makes it for 90 c., he does not get 5 per cent. but he gets 10 per cent. for himself. In other words, the higher the efficiency, the higher the pay.

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I have never learned to know the value of possessions as such. To me possession is personal effort. I have often heard Mr. Carnegie say, "When I sign a check for a million dollars for some educational or other institution, I do not feel that I have contributed anything more to it than the work of signing the check." It is the man who gives personal effort to things who deserves the credit for the doing of them.

The great thing in life is happy accomplishment; the great thing in life is enterprise successfully accomplished. The great throb of pleasure that comes to you when you set out to do something, and when you have done it successfully, is worth all the money in the world. It brings a sense of satisfaction that no possessions of wealth will bring. Accomplishment well performed, and successfully accomplished, that is the thing the true American spirit works for.

I have had 43 years' business experience. I have been an optimist all my life as to American business. If I have made a fortune, if I have constructed great works, which is more important, and great enterprises, it has been because I have had belief in American business and America in general. Mr. Morgan, the great financier, always said, "Always bet on the United States. Never be short on the United States."

When I started business, in 1879, in steel the whole country produced less than a million tons a year. Today, we produce fifty million tons a year, and after these 43 years of business trials and tribulations I am bound to say that I see a greater future at this period of my life than I ever saw at any period of the 43 years gone by.

## Another Coal Strike Ahead

THE most serious factor in the situation ahead of America is the prospect of another coal strike in five months, says the National City Bank of New York, in one of its recent monthly reviews of economics and business, and continues:

The contract between the bituminous operators and miners will expire April 1 and there is little chance of their readily reaching an agreement. Moreover, as little opportunity will be afforded in the meantime to accumulate stocks, the situation will become critical very quickly after mining is suspended in the union fields.

The Borah-Winslow act passed by Congress at the last session provides for a fact-finding commission, to be appointed by the President, which it is hoped will be able before next April to lay before the country information which will enable Congress to deal intelligently with the problem. The President has named a commission which commands general approval as composed of men with technical knowledge, broad public views and experience in dealing with labor problems.

The commission will inquire into the ownership of mines, prices of coal, organizations, persons and methods having to do with production and distribution, profits of producers and distributors over the last ten years, labor conditions, wages, waste, irregular production, causes of labor disturbances, etc. Unquestionably this is the way to prepare for authoritative action. If the commission will discover and describe the conditions the public will be better able to judge what should be done. The situation, however, is very complex, and it will be remarkable if the commission is able to agree upon recommendations, even if it is agreed upon the facts.

It is already known that there is an excess of competition in the business—too many mines and too many miners for economical production. Some of the ablest men connected with the industry have insisted that the true remedy was in the perfectly free play of economic forces, in other words, such unrestrained competition as would throw the business to the low-cost mines and eliminate the others, providing steady work to enough miners to supply the demand and forcing the others to seek another industry.

It will be interesting to have the commission's explanation of why this does not occur. Apparently, there is restraint of some kind upon competition, either in the facilities for transportation, or by some means that prevents the more efficient mines from taking the full volume of business they are capable of handling. It probably will be found that the trouble is not in the free play of economic forces but in something that hampers them.

It does not require a government commission to find out that consumers of coal cannot afford to pay full annual wages to miners for working only 200 days in a year. Its findings, no doubt, will be of great value, but we know already that unless a great deal more coal is needed a large working force should be transformed out of the coal industry, and wages readjusted accordingly.

## South Africa Honors Colonel Dwight

PRESIDENT DWIGHT has been made an honorary member of the Chemical, Metallurgical and Mining Society of South Africa for the year ending June 30, 1923. This is an evident manifestation of the good feeling which exists between the technical men of South Africa and those of the United States.

In the early years of gold-ore development in South Africa, American engineers took a prominent part, and were present while that country was taking the premier position in the world's production of precious metals, and while a younger generation was being educated to take the place of the pioneers. That younger generation now fills the positions of responsibility, and it is gratifying to those who have returned home to realize that, though few Americans remain in the Transvaal, there still remains a strong bond of friendship between the present generation of technical men and their fellow workers on this side of the Atlantic.

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# Technical Education and National Character

By HENRY H. KNOX

Consulting Mining Engineer, New York City

AMIDST the tumult and the shouting of the times, there are perceptible certain tendencies, quiet though serious, to take stock of the situation with a view to putting our house in order, and of these none is more encouraging than the awakening interest in the higher education, and especially in technical education. Various committees of the professional organizations have cast much light on the matter and have pointed the way to progress and reform, but their scope is necessarily restricted by the requirements of precision and any excursion beyond these bounds must be undertaken by the unfettered individual who is free to rush in where responsible committees fear to tread. A discussion of the bearing of the higher education on character scarcely lends itself to objective treatment and yet, fraught as it is with imponderables and abstractions, the theme cannot be escaped in any comprehensive scheme of education.

The question is being pressed with growing insistence, why these United States, relatively to Europe, are deficient in intellectual output, and the ready reply, "Because America is a new country and Americans are too intent on developing their natural resources," is too facile and too false to carry conviction.

## United States Depends on Foreign Intellectual Output

America is no longer young and Americans are under no more constraint to earn their living than are Europeans. We must delve a little deeper into causes if we would discover why no American has been numbered among the pioneers of any of the profoundest speculations and discoveries that have revolutionized modern thought, such as organic evolution, radiant energy and the constitution of matter; and furthermore, why Americans are not counted among the foremost of those who have developed such conceptions after they have been announced. Even in the execution of great engineering projects, is there no significance in the fact that New York owes to foreign skill her Brooklyn Bridge, her Hell Gate Bridge and her river tubes?

In explanation, one may leap to the conclusion that the conditions of our national life are producing a race of engineers and industrials like the Romans, devoid of the abstract creative faculty and drawing their science, art and letters from Europe as the Romans drew theirs from Greece—a conclusion that is wrong only because it is extreme. That we are capable of autonomy on certain lines is demonstrated by American eminence in astronomy and geology, medicine, psychology and philosophy and native ability has lately been brilliantly attested by a high order of scientific and inventive accomplishment under the stimulus of war. The question becomes, then, not why we produce nothing, but why we do not produce more. The limits imposed by the objective confine the scope of this inquiry to the basic sciences underlying the mineral professions; that is, mathematics, physics and chemistry. Has America contributed her fair share toward the advancement of these sciences and the application of their principles to the mineral industry or does she merely stand in the light cast by Great Britain, France, Germany and Italy? Let us see.

## America's Contribution to Science

In the pursuit of enlightenment, suppose we select any typical mine and inquire what the management owes to American initiative. Beginning at the power plant, if steam is the motive power, we find that Parsons, the Englishman, is directing its force by means of the steam turbine; if internal combustion, the Germans, Otto and Diesel, have shown the way; if hydroelectric, the Frenchman Poncelet's reaction wheel is driving a generator developed from the machine of Gramme, another Frenchman. The polyphase current generated is the offspring of the brains of the Italian Ferraris and the Hungarian Tesla. If our mine is producing the precious metals, they are being extracted by methods developed in South Africa, or the useful minerals are recovered by an operation worked out in Australia. If smelting is practiced, it is safe to say that there is scarcely a step in the process that has not been imported from abroad. The names of Pelton and Cottrell will spring to the mind, but otherwise what American engineers have contributed fundamentally to the advancement of the art? With prodigious enterprise and ability, they have adapted to our conditions methods and inventions drawn from foreign lands. Indifferent to science, careless of principles, impatient of sustained thought and remote aims, intent only on

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his immediate task, the typical American engineer is content to improve machines others have invented, to expand processes others have devised. As Kipling has observed, "He turns a keen untroubled face, home to the instant need of things."

Before I am refuted with a list of American men of science and technicians to whom the industry is indebted for new principles, I invite the objector to remember how many are foreign born and educated. The Franklins, Henrys, Rowlands, Gibbses and Michaelsons we can claim as our own, but not the Teslas, Pupins, Steinmetzes and Bells, who by birth and training are Europeans. It is indeed impossible to escape the conclusion that, broadly speaking, America is a laggard in the march of intellectual progress even to the extent of lending color to the epigram that it is the richest in talent and the poorest in genius of any country in the world. That this situation is a menace to our national well being, spiritual, moral and industrial, will not be disputed by those who concede the premises but, since the causes are in no wise mysterious, the remedies lie close at hand if a compact body of opinion, however small, can be brought to bear on reform. Let us endeavor to trace the inductive chain from effects to causes.

As it appears to me, the ordinary graduate in engineering leaves his alma mater provided with an equipment of facts and, we will admit for the moment, sufficient instruction in the natural sciences to prepare him to earn his living and to acquit himself creditably in his career—but of love of science he has nothing. He reads the technical press and the transactions of his professional organization, but on his book shelf will not be found a single volume on pure science and his name is absent from the membership lists of the scientific societies. Because the love of science has not been inculcated in him he confines his interest to the day's work, to proximate results, and remains for life blind to ultimate principles and broad conceptions. This is the man who will hail with lively interest, if it bears directly on his own work, the product of another's arduous research or the flash of inspiration born of wide knowledge, but he is not the man of whom profundity of thought or breadth of vision can be expected.

### Too Raw Material Fed to Our Technical Schools

The signs are not wanting of an awakened attention to the raw material being fed to the technical schools and of a growing perception that an education limited by the degree of mining engineer (or, indeed, any other diploma) is an insufficient preparation for life. Turning to Europe, we find that the great majority of students begin their higher education only after completion of a course at a *lycée* or *gymnasium*, which is equivalent to the academic course at an American university. And just here the pronouncement of one of the most distinguished naval officers of his time on the value to the technician of a liberal training is of striking interest: Says Admiral Sims, in the light of his intense war experience, "I have even been inclined to suggest that it would be well, in the training of naval officers in the future, to combine a college education with a shorter intensive technical course at the Naval Academy. For these college men have what technical academies do not usually succeed in giving—a general education and a general training, which develops the power of initiative, independent thought, an ability quickly to grasp intricate situations, and to master in a short time almost any practical problem." Here, I think, Admiral Sims and certain of the engineering committees are at one in deprecating specialization before the mind has been expanded and prepared by grounding in general knowledge. Even then specialization should be sharply scrutinized before admission to the curriculum. No more glaring example of pernicious specialization can be found than in the current tendency to teach peculiar varieties of English—commercial, engineering, or what not. Far better would it be to teach the student no English at all, but to tell him emphatically what is the truth, that the only English that will save his reports from the waste basket is literary English. And so with the sciences; their modes of application change with the times while science itself is eternal.

### When Devotion to Science Must Begin

It is in the formative years at college, if ever, that a devotion to science can be impressed on the student. This effect is the result of many things but of none more potent than the direct influence of the teacher, not of his precepts but of his personality, for a professor may project a more abiding influence from the solitude of his study than from the class room. To the pupil no inspiration can equal the pride in the fame of his master and the consciousness that he is as widely known and honored throughout the world as even the 'Varsity quarterback. It would be no easy task to estimate the full effect on current science of those extraordinary men who successively have filled the chair of physics at Cambridge—Lord Rayleigh, Clerk Maxwell, J. J. Thompson and Ernest Rutherford—since to their own achievements would have to be added the brilliant contributions of the band of scholars trained by them and, above all, inspired by them.

How shall that old-world scholastic atmosphere be translated to our own seats of learning, that they may be aroused to a higher life and quickened to a new spirit? First, I should say, by relieving the teaching staff of the burden of administrative work that distracts them from their true function, to the end that they may devote themselves more freely to original work; secondly, by granting them a living wage that will remove the apprehension under which the best work is impossible; and, thirdly, by instructing the student in the history of science, for history vivifies

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the study of science by associating with its pursuit human emotions and romance, emulation and triumph. The recognition that Hero's whirligig was the forerunner of Parsons' turbine, that Archimedes begat Leonardo, that without Pythagoras Descartes could not have been, must dignify the student's own fancies and stimulate him to follow them through to a conclusion. Indeed, there is a growing appreciation of the importance of this subject as an incentive and several of the universities have established such courses.

The feature of our educational system that is the most discouraging of true scholarship and, because it is intangible, the most difficult to combat, is the spirit of commercialism that permeates our higher institutions of learning. The army and navy recognize the preponderant value of personnel over materiel, but in the higher education the standard is that of size; the aim is ever toward greater enrollment, bigger endowments, more magnificent buildings, and only too often the president is chosen for his business capacity and ability to collect funds while scholarship starves in the background. A prominent chemist and educator recently predicted to the writer that Europeans would flock to the schools of this country for higher instruction and research in chemistry and physics because of the lavish expenditure here on laboratory materials and equipment. I think he is mistaken because, as long as the exceptional few estimate men above material, the tide will continue to flow in the opposite direction. There are at present 180 American students enrolled at Oxford, 60 at London, 37 at Cambridge and 21 at Edinburgh, while increasing numbers may be expected at Paris and Strasbourg of those who cross the sea in search of a standard of scholarship unobtainable at home.

Should my fellow members admit my contention that the level of technical education must be raised if the United States is to advance to the first rank in intellectual progress, I urge them to exert individually such influence as they may toward the reduction of the materialistic spirit that depresses the tone of our educational institutions and the introduction of such conditions as make for that idealism more generally prevalent abroad. Furthermore, I propose that collectively the Institute make a formal pronouncement in favor of including in the curricula a course in the history of science, and that it demand for the faculties more liberal pay and such relief from routine as to permit and encourage the teachers to devote their best abilities to original work, all to the end that the atmosphere surrounding the student may animate him to higher aspirations.

I shall have failed of my purpose if these reflections should be understood as advocating an attempt to make of the engineering student a man of science. Even if possible, this would be undesirable, perhaps fatal. The man of science and the engineer envisage the world from different angles; the former pursues absolute truth, the latter material ends, and both will fail unless they hold true to their objective. On the continent of Europe the tendency has been too far in the opposite direction, with the result that in general European engineers can fairly be criticized for a devotion to theory to the detriment of practice. Therefore, with the happy medium kept steadily in view, what is urged is that science should be so taught in our schools that, instead of fading into a withered memory in later life, it would remain throughout a living, growing thing and so become a diligent handmaid of engineering. It would be absurd to affirm that an engineer can retain an equally vivid interest in quaternions, colloidal chemistry and the potential theory, but it is averred that by proper educational methods the profession can be so leavened with men proficient in some branch of science that it will become more productive of original ideas. It has been done; it can be done. Let our schools learn from Cambridge and the École Polytechnique how it is done.

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## Engineering Foundation Research Purpose

By Alfred D. Flinn*

AMBROSE SWASEY, of Cleveland, Ohio, a leader among the mechanical engineers, eminent for his personal attainments, perceived the desirability of establishing for the engineering societies a fund and an organization to be devoted to research. In 1914, he offered $200,000 to the four national societies of civil, mining and metallurgical, mechanical and electrical engineers, as a nucleus of the proposed fund. This generous gift was accepted and committed to United Engineering Society, a board of twelve trustees, which had been created by the societies in 1904 and incorporated under New York laws, to hold and administer Engineering Societies Building and Library and other properties belonging to these societies jointly. At the request of these so-called Founder Societies, United Engineering Society created a department known as the Engineering Foundation Board, to have full power in expending the income of the endowment. The high purpose which Mr. Swasey and those who collaborated with him in organizing the Foundation had in mind has been well stated as being the furtherance of research in science and in engineering and the advancement in any other manner of the profession of engineering and the good of mankind. Subsequently, Mr. Swasey made other gifts, bringing his total to one-half million dollars. Assurances of legacies have been received from other persons.

The income of even a half million dollars does not go far in modern research projects. The scale is indicated by the fact that a number of enterprising American corporations have each been devoting annually from a few hundred thousand to three or four

* Director, Engineering Foundation.

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million dollars, not to mention the large sums appropriated for research by the Federal Government. Nevertheless, by using its resources coöperatively, Engineering Foundation has to its credit a number of useful services. Its first coöperative project can hardly be excelled in results.

In 1916, some of the leaders in the scientific associations and engineering societies realized that the United States could not much longer refrain from participation in the World War. They also perceived that science, technology and industry were proving quite as essential to success in the struggle as were military skill and financial resources. It was also evident that the three factors must combine in their efforts. Out of these convictions, through the medium of a meeting in New York, came the National Research Council, based on the charter of the National Academy of Sciences given by Congress in 1863, to bring together the scientists of the country for aid to the Government in the war then in progress. When organized, National Research Council had no funds. Engineering Foundation had as yet undertaken no project. Its board at once offered the Council an office in Engineering Societies Building and the services of a secretary, devoting all its income for a year, besides funds specially raised. This prompt succor did much toward assuring the permanent establishment and success of the Council. The magnitude of the service thus performed by the engineering societies through the Foundation will appear in part from statements which follow.

Engineering Foundation is a joint instrumentality of the engineering societies for the support and advancement of research. It is also a bond between scientists and engineers because it maintains its cordial relations with National Research Council. Besides its share in the establishment of National Research Council, the Foundation has to its credit a new form of weir for measuring water, resulting from experiments by Clemens Herschel; "Directory of Hydraulic Laboratories in United States of America," recently published; research in determination and measurement of internal stress in metal, now in progress in Columbia University laboratories; an inquiry into the feasibility of establishing a testing station for large water wheels and other large hydraulic equipment; "Research Narratives," published semi-monthly since January, 1921. The first forty Narratives, recording instructive and interesting incidents in research and invention, may soon be done into a book for use in secondary schools and other educational institutions and to meet constant requests for Narratives which are out of print. In addition, a number of important preliminary investigations have been made, but lack of funds or other reasons have deterred the Foundation from undertaking the projects or carrying them through. Of these there may be named industrial education and training; mental hygiene of industry; organization among engineers; wear of gears.

The Foundation's coöperative projects are still among its most noteworthy: Spray concealment for vessels; fatigue phenomena of metals; "Directory of Research Laboratories in Industrial Establishments in U. S. A."; highway research; personnel research; graphitic corrosion of iron; arch dams; reinforced-concrete multiple arches; wood-finishing processes, including paints and varnishes; selected hydraulic problems. These projects range through various stages of progress from recent initiation to completion. Besides the National Research Council, the coöperators include industrial establishments, engineering offices, universities and technical societies. In addition, the Foundation has been helpful to engineers, industries, societies and other organizations in various parts of our own and other countries, and to a few governments in modest ways, for information and suggestions.

Copies of the Foundation's *Publication* No. 4, containing a report for its seventh year and a report on Research in Fatigue of Metals, will be sent on request addressed to 29 West 39th Street, New York.

## River Coal Being Used

RIVER coal has been playing a part in the relief of the fuel stringency. For years fine coal from the anthracite regions has been carried down the Susquehanna and other rivers. Deposits have been left on the beds of these rivers in many places and particularly where dams and obstructions occur. Two Pennsylvania steel companies are daily removing, from one river running by their plants, many tons of this buckwheat anthracite and are using it for making steam. One of the companies makes it a part of its open-hearth furnace charges. Near Baltimore a large metallurgical company, which uses water power for its manufacturing operations, has for some time been selling this grade of coal, removed in large quantities from behind its dam. While the necessity for turning to them may be removed when anthracite production is again ample, these river deposits will probably be drawn upon for some time to come.—*Iron Age.*

## Westinghouse Lecture and Motion Picture Service

THE Westinghouse company has available sixteen lectures with slides, on subjects such as Arc Welding, Electricity in Steel Mills, and Radio Communication. It also has five motion pictures dealing with the use of electricity. Full information may be obtained from the Educational Department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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# Autogenous Blende Roasting

By W. R. INGALLS

Consulting Engineer, New York City

MANY years ago, I expressed the opinion, in writings and otherwise, that it was possible to desulfurize zinc blende autogenously, *i.e.*, without the use of extraneous fuel, and that at some time this would be accomplished. This opinion was based on thermal calculations and also on observations of the behavior of blende during roasting in different ways, all of which observations tended to confirm the theoretical calculations. Among such observations were things like the following: Once in carrying out the stall roast of cupriferous pyrites as a regular metallurgical operation, I was minded to charge a stall with lump blende, ranging from walnut to egg size, as I recollect, following the same procedure as with pyrites, and setting fire to the kindling wood, observe what would happen. The blende charge ignited well enough and bravely began to burn, quite actively the first day, at a diminished rate the second day, while on the third day burning ceased and the charge quickly became cold. It was just like trying to set a grate full of anthracite afire with insufficient kindling wood. The volume of air drawn through the stall was too great, quickly cooling the entire contents below the ignition temperature, which means, of course, that burning ceased.

## Prophesies of old Furnaces Fulfilled

I had an opportunity to observe the operation of Gerstenhofer kilns on blende roasting at Freiberg, in Saxony. These old kilns, which are unknown to metallurgists of the younger generation, were built in batteries that were subject to the minimum of heat radiation from their external walls and that permitted a careful control of the volume of air for oxidation. In such kilns blende fines were burned down to about 3 per cent. sulfur without the use of any extraneous fuel.

We knew, also, from pyrometric determinations of the Rhenania furnace, which was very well designed from the standpoint of heat conservation and was built with the acme of good masonry, that in certain operations of the furnace there was the development of a good deal more heat than was needful. Of course it was a matter of common knowledge that with such furnaces, and later with the Delplace and others, the requirement of coal for the dead-roasting of a ton of blende was reduced to a very small percentage, whereas with some badly designed furnaces like the Zellweger that we used to use in Kansas, the conditions were very much like trying to roast blende by means of a bonfire and the percentage of coal consumption was very high.

I could dwell upon such observations at considerable length, but there would be no particular interest in it and there is no use in adding anything more than the remark that such observations in a general way were in tune with the theoretical calculations. In 1905 I took out a patent, more for having the ideas on record than anything else, on what I thought a blende-roasting furnace ought to be. The drawings and specifications showed a multiple-hearth furnace of the McDougall type, the distinguishing features of which were the thick external wall for the purpose of confining the heat and an arrangement of stirring arms providing for the positive circulation of air through them, primarily, of course, for the purpose of keeping them cool. However, the air that had become heated in accomplishing that purpose was piped from the top of the central column to a vertical flue in the external wall from which it could be introduced into those hearths where there would naturally be a deficiency of heat. The fundamental ideas of this furnace were conservation of heat and transfer of heat from those parts where there was a surplus to other parts where there would be a deficiency.

All of this is prefatory to reporting that what was prophesied so long ago has at last been substantially accomplished with a modification of the well known Wedge furnace that was built and has been operated during the last year or so by the National Zinc Separating Co. at Cuba City, Wis. This furnace, which is shown in the accompanying drawing, embodies the air cooling of the stirring arms and the heat transference through the medium of the air used for that purpose that were shown in my old design. The exterior of the furnace does not have so thick a wall as I contemplated, but it is well insulated, nevertheless. The modified Wedge furnace, which for convenience is being called the "Ord" furnace*, has a new and different feature in the provision for by-passing some of the ore during roasting from an upper to a lower hearth, skipping some intervening hearths, which serves the purpose of transferring sulfur for burning on the lower hearths.

I have followed the experimental work at Cuba City, as it has gone along, and my friend, Leslie Webb, has communicated to me some late results, which it is of

*U. S. Paten to Carl S. Fogh, No. 1362408, Dec. 14, 1920.

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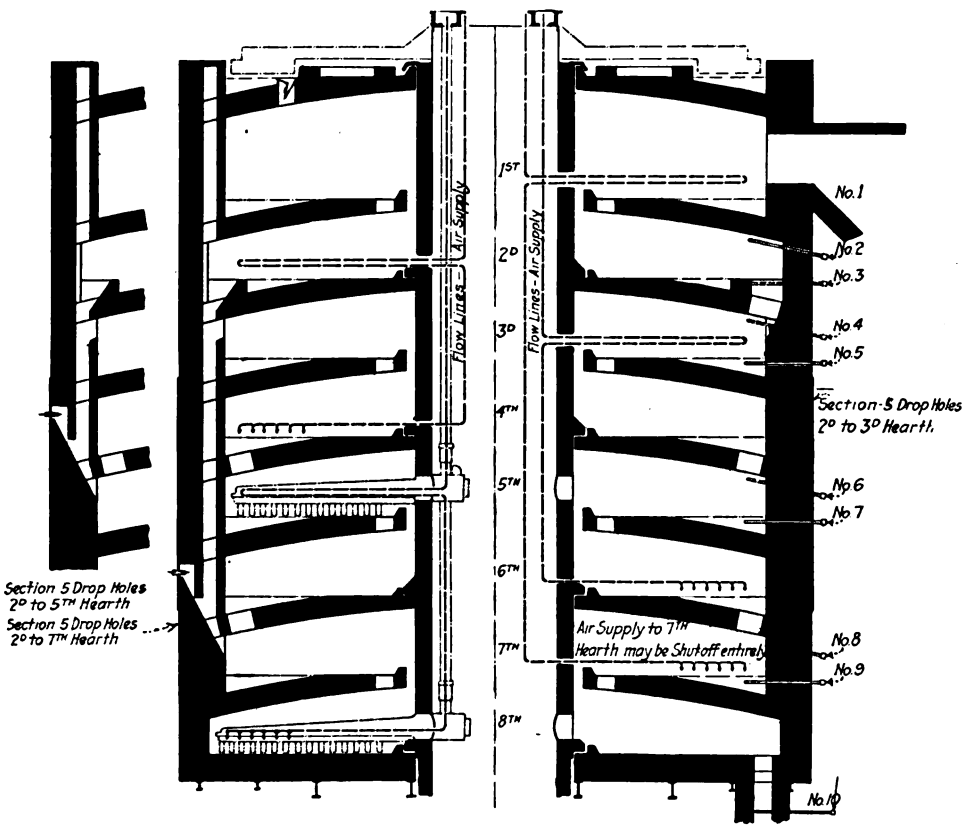
interest to report in the form of a summary in his own words, as follows:

In the latter part of July and the early part of August, 1922, we had the benefit of a commercial operation of this furnace roasting Wisconsin blende concentrates. These concentrates average about 60 per cent. zinc, 30 per cent. sulfur, and have a magnesia and lime content tending to the formation of calcium and magnesium sulfates, which has to be taken into consideration in considering the total sulfur content in calcines of these particular concentrates.

The furnace used is of the Wedge type, modified in construction so as to fit the new purpose. It is 25 ft. in diameter and has eight roasting hearths plus top arch, making nine arches in all. The walls of the furnace, the shaft and the bottom hearth are insulated with Armstrong cork brick in addition to fire brick.




SECTION THROUGH ORD OR MODIFIED WEDGE FURNACE.

An essential feature of the Ord furnace is the arrangement for by-passing the roasting ore between the several hearths in order to obtain a desired distribution of the ore, preheated in the upper part of the furnace, among the lower reaction chambers. Reference to the accompanying drawing will show that a part of the drop holes from the second hearth are directed to the third hearth, while a part lead to the fifth hearth and a further part to the seventh hearth. All told, there are 15 drop holes from the second hearth, the first leading to the third hearth, the next one to the fifth hearth, the next one to the seventh hearth, the next one to the third hearth and so on around the circle. The ore as discharged from the second hearth is raised to the temperature where roasting begins.

There is control over the draft, the air being introduced by a fan through the arms in tandem. The cold air was introduced through arms on the first hearth and discharged through arms on the seventh hearth, likewise in tandem through the second and fourth; third and sixth; fifth and eighth. The arms receiving the cold air, which makes a complete circuit to the outer ends and return, are cast iron; the arms through which hot air is discharged are built of thermalloy, made by the Electro Alloys Co. of Elyria, Ohio. With this system we secured hot air approximating 390° C. for drafting the furnace.

The accompanying drawing shows the placing of the pyrometer rods, giving readings of the temperatures at various points of the furnace. The rods shown in dotted lines at first glance may appear to be under the drop holes but are, in fact, located between the drop holes. These rods gave us the readings of the gas temperature, the others giving us the readings of the ore temperatures. The copy of daily log of Aug. 7 is typical of the temperatures secured during the test.

Gas determinations throughout the tests indicated an average of approximately 6 per cent. sulfur dioxide, by volume. The furnace was operated in connection with a contact acid plant, which was built for a lean gas. Consequently, false air was admitted through the coke boxes, which gave a gas for acid production, running about 4.70 per cent., and it ran very uniformly. The furnace was operated at various tonnages, ranging from 25 tons blende charged per 24 hr. up to 37.8 tons. The best results appeared to be secured around 25 tons. A screen test of the ore charged to the furnace showed approximately 25 per cent. plus 40 mesh, about 25 per cent. plus 60 mesh and about 50 per cent. passing 60 mesh.

Our research work, previous to this actual commercial operation, indicates that we should have fine material (about 60 mesh) for a dead roast, which fineness could probably be expected in all flotation concentrates.

Samples of the calcines were taken hourly and a composite sample for each 8-hr. shift. Fine calcines, passing 60 mesh, showed fault sulfur averaging under 1 per cent., the lowest we secured being 0.7 per cent. When the furnace was allowed to operate under normal

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conditions, that is, not changing various factors, which we naturally did during the test, we secured calcines having, by analysis, a total sulfur content of around 3.5 per cent.

At no time during the test did we experience any mechanical difficulties, and by changing conditions, such as draft and feed, we were able to raise or lower temperatures almost at will. In fact, we did not use any oil even in starting up the furnace. The furnace was heated in the usual manner incident to multiple-hearth furnaces, using some fuel at the start, then pyrites. After that we changed the feed to iron monosulfides and brought the temperature up to over 800° C. and then charged the blende concentrates, which brought up the temperatures as shown in the log. At no time was there any tendency of the furnace to freeze.

*Furnace Temperature (Centigrade) at Cuba City, Aug. 7, 1922*

| Time of Observation | Flue Gases, No. 1 | 2nd. Hearth | | 3rd Hearth | | 5th Hearth | | 7th Hearth | |
|---|---|---|---|---|---|---|---|---|---|
| | | Gas Rec. No. 2 | Bed, No. 3 | Gas, No. 4 | Bed, No. 5 | Gas, No. 6 | Bed, No. 7 | Gas, No. 8 | Bed, No.9 |
| 7:30 | | 850 | 810 | 840 | 827 | 840 | 812 | 817 | 819 |
| 8:30 | | 850 | 810 | 839 | 824 | 841 | 810 | 817 | 818 |
| 9:30 | | 850 | 810 | 838 | 825 | 840 | 810 | 815 | 816 |
| 10:30 | | 850 | 810 | 835 | 825 | 840 | 809 | 814 | 816 |
| 11:30 | | 840 | 809 | 835 | 825 | 839 | 807 | 813 | 815 |
| 12:30 | | 840 | 808 | 834 | 823 | 839 | 808 | 811 | 814 |
| 1:30 | | 850 | 808 | 835 | 824 | 839 | 808 | 811 | 814 |
| 2:30 | | 820 | 805 | 835 | 825 | 837 | 810 | 810 | 816 |
| 3:30 | | 850 | 808 | 835 | 825 | 837 | 812 | 812 | 817 |
| 4:30 | | 850 | 808 | 837 | 827 | 839 | 812 | 811 | 819 |
| 5:30 | | 840 | 811 | 840 | 830 | 841 | 815 | 812 | 821 |
| 6:30 | | 840 | 812 | 840 | 831 | 840 | 815 | 810 | 820 |
| 7:30 | | 840 | 812 | 841 | 831 | 841 | 816 | 811 | 820 |
| 8:30 | | 840 | 812 | 841 | 832 | 841 | 816 | 814 | 821 |
| 9:30 | | 840 | 813 | 841 | 832 | 841 | 818 | 814 | 821 |
| 10:30 | | 850 | 814 | 842 | 833 | 841 | 818 | 815 | 821 |
| 11:30 | | 840 | 814 | 843 | 833 | 840 | 816 | 817 | 820 |
| 12:30 | | 845 | 814 | 843 | 835 | 842 | 816 | 816 | 822 |
| 1:30 | | 850 | 816 | 847 | 837 | 845 | 818 | 818 | 824 |
| 2:30 | | 850 | 818 | 848 | 837 | 847 | 819 | 819 | 824 |
| 3:30 | | 850 | 820 | 849 | 837 | 849 | 820 | 822 | 825 |
| 4:30 | | 850 | 821 | 849 | 840 | 850 | 820 | 822 | 826 |
| 5:30 | | 850 | 822 | 850 | 840 | 851 | 821 | 821 | 826 |
| 6:30 | | 860 | 821 | 850 | 840 | 848 | 820 | 821 | 827 |

Of course, we learned some points in detail construction from this test and will take advantage of this in the construction of the two furnaces now being built for the American Zinc Oxide Co.'s plant at Columbus, Ohio, which will be our first autogenous zinc-roasting installation following the test at Cuba City.

A great deal of credit in connection with the proving of the Ord furnace at Cuba City is due to the management of the National Zinc Separating Co., which evinced its confidence in numerous ways.

The log of the furnace operation on Aug. 7, 1922, shows remarkable uniformity of temperature, not only as to time intervals but also among the several hearths. On this date the furnace was operated at the rate of 25 tons per 24 hr. The blower pressure corresponded with $4\frac{7}{8}$ in. of water, while the draft was $\frac{3}{32}$ in. The speed of the center shaft was one revolution in 95 seconds up to 3:45 p.m. when it was changed to one revolution in 106 seconds.

Gas determinations at 10:30 a.m. showed 6.4 per cent. sulfur dioxide by volume on the second hearth, 5.9 per cent. on the third and 4.1 per cent. on the seventh.

## American Engineers in Cuba Honor Charles F. Rand

THE Association of Members of American National Engineering Societies in Cuba has elected Charles F. Rand to honorary membership. Mr. Rand's work in Cuba in the development of the iron mines is well known to all of his colleagues and members of the Institute. It was for this work that several years ago he was decorated by the King of Spain.

The letter from the Association inviting Mr. Rand to Cuba to a banquet in his honor and also appreciative of the visit of Calvin W. Rice, secretary of the American Society of Mechanical Engineers, on his return from his trip to the Engineering Congress at Brazil is as follows:

We have just had a most interesting and inspiring visit from Mr. Calvin W. Rice, who was en route from the Exposition held recently at Rio de Janeiro, Brazil.

Mr. Rice brought us an inspiring message not only from the great Engineering Societies of the U. S., and Canada, but also from the great engineering genius, the Hon. Herbert Hoover, Sec'y of Commerce in President Harding's Cabinet.

It has been the custom of our association for several years past to invite one or more members and officers of the American National Engineering Societies to be with us at our annual meeting to be held on Friday, Dec. 8, and it, therefore, gives me great pleasure to extend such an invitation to your good self, so that you may be present personally to accept the Honorary Membership in our Association, which will be conferred upon you at that time.

If you find it impossible to arrange to be here on the date mentioned, we will simply hold our annual election of officers on the night of Dec. 8, and postpone the banquet to suit your convenience.

## Ford Railroad Deficit

A NET operating deficit of more than three hundred thousand dollars on the Detroit, Toledo and Ironton Railroad for the month of August is likely to surprise those people who a few months ago were advocating the turning over of the railroads of the country to Mr. Ford on the ground that the motor-car manufacturer had made so much money on this industrial road that he must know all about the great business of transportation. All that it was necessary to do, it appeared, was to dismiss the railroad managers and put him in charge; then the public would be given service at low cost and the employees be paid fabulous wages. And for a long time many really believed that the little road to the big automobile factories was being run on new principles.

But the record of performance tells a different story. Apparently the road has been run very well indeed. There seems to be no criticism on that score. Yet the August figures indicate that when business falls off and expenses are high there is no magic way of avoiding a deficit. The logical conclusion is that the presidents of railroads like the Pennsylvania, the Baltimore and Ohio and the New York Central have no reason for going to Detroit for instructions.—*Traffic Review.*

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## James Douglas Gold Medal

THE announcement was made in the October MINING AND METALLURGY of the gift of a fund to provide a gold medal annually in perpetuity in memory of Dr. James Douglas, twice president of the Institute, and recipient of numerous degrees and medals for his achievements in non-ferrous metallurgy.

After a careful study of the work of various artists, the committee selected Anthony de Francisci of New York to execute the design of this medal, with particularly happy results. The design is a very beautiful one and is not only a commendable addition to the artist's already considerable list of achievements but is also a matter of great pride to the Institute. The likeness of Doctor Douglas on the obverse side is unusually true and minute in detail. The reverse side shows a primeval furnace operated by two nude figures in front of a tunnel, the receding roof lines of which are plainly visible. There is a subtle classical touch in portraying these prosaic subjects which adds charm to the design. The origin of the theme of this design is of particular interest because it was suggested by an old photograph made by Colonel Dwight of an ancient adobe furnace in Mexico where Doctor Douglas did some of his earliest work.

Besides the title of the medal and a place for the inscription to the recipient are the Institute's cross hammers and the old alchemistic symbols representing gold, silver, lead, copper, zinc and tin, for work in the metallurgy of which the medal is to be awarded.

JAMES DOUGLAS GOLD MEDAL TO BE AWARDED FOR NON-FERROUS METALLURGICAL ACHIEVEMENT.

### RULES OF AWARD

The rules of award as submitted by the committee and adopted by the Board of Directors are:

1. The medal to be awarded once a year, preferably at the time of the annual meeting; but this procedure may be varied at the discretion of the Directors. The medal is to be accompanied in every case by an engrossed diploma containing a citation of the service or achievement upon which the award is based.

2. Eligibility.

(*a*) Distinguished achievement in non-ferrous metallurgy.

(*b*) No limitations as to nationality, membership in the Institute or otherwise.

(*c*) Recipient must be a living person, able and willing to present himself in person to receive the award at the time and place to be prescribed by the Board of Directors.

3. The choice of a recipient is to be based upon a report by a committee of seven, six of whom shall be chosen by the Board of Directors from members of the Institute interested in non-ferrous metallurgy, whose tenure of office shall be so arranged that the terms of two shall expire every three years in rotation. A member shall not be eligible for re-appointment to the Committee for a period of one year after his term has expired. The President shall be *ex officio* a member of the Medal Committee, but not its chairman. The award shall finally be made by a majority vote of the Board of Directors, after a full consideration of the report by the committee. The Directors shall have the right to reject the report of the committee.

4. The committee may call on the membership for nominations, but such nominations must be accompanied by a detailed argument in favor of the award and details sufficient to permit a proper citation to be drawn. The committee may circulate this invitation for suggestions by a special letter direct to the membership or by publishing an appropriate notice.

The committee suggested and the Directors approved the form of diploma, which follows in general that prescribed for recipients of the John Fritz Medal.

The committee having in charge the selection of the artist and the formulating of the rules of award comprised: A. R. Ledoux, chairman; Walter Douglas, Arthur S. Dwight, W. R. Ingalls, H. A. Prosser, Charles F. Rand, B. B. Thayer, George C. Stone, Arthur L. Walker.

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**Explaining** Soviet reversion to capitalism, Lenin said: We went too far and we have found nothing is final, that alway we must learn from circumstances. We found the peasants and the small bourgeoise that form the vast numerical majority of our country were against us. To retain power we had to satisfy them."

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# Modern Tank Steamships

By JOHN G. PEW

President, Sun Shipbuilding Co., Philadelphia, Pa.

PRIOR to the development of the bulk-oil carrier, practically all transportation of oil was in barrels and in cans contained in wooden cases; the latter was known as case oil. In the year 1885, approximately two hundred million gallons of petroleum were exported from this country in barrels and about one and three-quarter millions in bulk; less than twelve years later, the shipment in barrels had decreased to nearly one and three-quarter million gallons, while the transport of bulk oil had increased to four hundred eighty-four million gallons.

The first modern tanker, the "Glückauf," was built in England in 1886. Her hull, which was 300 ft. long, was divided into compartments by transverse bulkheads, these compartments being divided by longitudinal center-line bulkheads extending throughout the oil spaces. There was a pump room forward of the boiler room, thus providing a cofferdam or safety space. Between the main and upper decks, a narrow trunk extended the full length of the oil spaces, the transverse and longitudinal bulkheads being carried to the upper deck. This allowed for the expansion of the oil from a rise in temperature, and if the tank below the main deck was kept full, the danger of the oil moving with the roll and pitch of the vessel was considerably reduced. Spaces for the carriage of light oil were provided on each side of the vessel outboard of the expansion trunk, while water ballast was carried under the machinery compartments fore and aft. Although vessels previously had been built to carry oil next to the skin of the ship, it is claimed that the "Glückauf" was the first one constructed on the new principle outlined.

## Increase in Size of Tankers

Before the year 1915, the average deadweight of bulk-oil steamers was less than 6000 tons, but it has increased in this country to nearly 10,000 tons. The largest bulk-oil steamer, the S. S. "William Rockefeller," registers 20,000 tons; it is owned by the Standard Oil Company.

With the increasing size of bulk-oil steamers came the "shelter decker." Before the first shelter decker was built, practically all oil steamers were of the "well deck" variety, which consisted of a continuous upper deck, upon which were built a poop, bridge and forecastle deck; these formed what was commonly known as a Three Island Type vessel. A shelter deck vessel, on the other hand, has three continuous steel decks, the uppermost being known as the "strength deck," and the first of this type carried the oil tanks to the upper, or one below the shelter deck. The oil hatches were on this upper deck, with gas trunks extending to the shelter deck. Experience, however, proved this arrangement to be a source of danger, because of the accumulation of heavy gases in the pockets between decks where miscellaneous cargo was stowed. The next step in the development of the shelter deck vessel brought the expansion trunks up to the shelter deck, where the oil-tight hatches also were placed. The summer tanks, used for carrying light oils, were arranged outboard of the expansion trunk below the upper deck, and between the upper and shelter decks were open spaces for miscellaneous cargo.

## Advantages of New Type Deck

The advantages of this design over that in which the oil is carried only to the upper deck are:

1. Increased strength longitudinally in the extension of longitudinal bulkheads to the shelter deck.
2. An increase of at least 10 per cent. in the cubic capacity of the trunks when carrying light oils.
3. Easier trimming of the vessel.
4. Higher center of gravity of the cargo making an easier rolling vessel.
5. Elimination of danger from gases accumulating in the spaces between decks, due to the oil-tight hatches being fitted on the shelter deck.

The following description explains the arrangement of tanks, cofferdams, etc., in a modern tank steamship built to carry 15,000 tons deadweight.

Commencing forward, there is the forepeak with a water-tight bulkhead at the after end; aft of this is a forehold intended for dry cargo only, and at the after end of this a water-tight bulkhead extending across the vessel and from the bottom of the ship to the oil-tight deck above. Four or five feet aft of this is an oil-tight bulkhead. The space between these two bulkheads forms a cofferdam which is filled with water when carrying dangerous oils, thus making a solid body between the forehold on the forward side and the oil tank on the after side of the cofferdam. There is a small pump room in the forehold, which is for use in the forward section of the ship only and isolates this part of the vessel from the cargo oil tanks.

The cargo tanks are usually numbered from forward, in numbers from 1 to 10 or 12, as the case may be, and

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are usually 24 to 28 ft. long. About amidships is placed the main pump room, containing two large cargo pumps, one on each side of the vessel. This room is usually 10 to 12 ft. long and is divided from the main oil cargo tanks by an oil-tight bulkhead at each end. Aft of this there are several cargo oil tanks, ending with No. 12, at the after end of which there are two oil-tight bulkheads with a space 4 to 5 ft. long between them, thus forming another cofferdam. Aft of this cofferdam come the fuel oil bunkers followed by another oil-tight bulkhead and another cofferdam. The after bulkhead of this cofferdam is the boiler-room bulkhead, so that the boiler and engine rooms are absolutely shut off from the tanks containing oil. There is a double bottom in the engine and boiler-room spaces for the carriage of feed water or water ballast, and back of this is the after-peak tank, which is usually fitted to carry fresh water.

In the more modern tankers the upper deck is omitted, thus making very deep summer tanks, and eliminating a large item of extra weight. The deep expansion trunk permits the vessel to be trimmed very easily, owing to the large or small ullages which are possible. The expansion trunk of a tank is never filled to the top, so as to provide for the necessary contraction and expansion of the oil in different temperatures, and the vacant space thus left in the tank is called the ullage, that is, the distance from the oil deck to the top of the oil in the tank. That is why the top part of the tank is called the "expansion trunk." Crude oil expands 1 per cent. for every 25° rise in temperature, and contracts an equal amount when the temperature falls.

### Accommodations for Personnel

Accommodations in modern tankers are very complete. The captain and officers have their quarters in a double tier of steel houses amidships; the engineers are located in steel houses aft on the shelter deck, and the crew have ample and commodious quarters, including mess rooms and pantries, below the shelter deck. A chart and wheel house and a navigating bridge are on the same level as the officers' quarters.

Lifeboats, sufficient to accommodate all persons on board, are fitted on each side of the vessel. There are cold-storage rooms, electric lighting, radio, steam-heating system, interior communication, drainage, fire main and deck service, steam steering gear, steam winches and windlass. The plumbing arrangements are usually complete, and include showers for seamen and firemen.

Practically all modern tank steamships are built on the Isherwood or longitudinal system; that is, all the framing runs continuously fore and aft, the transverse strength being taken care of by bulkheads and deep transverse frames spaced 9 to 12 ft. apart. This system of construction is especially suited to this type of vessel on account of the large reduction in weight and the increased longitudinal strength. The transverse strength of oil vessels is greater, owing to the transverse bulkheads and transverses, but there is no such large margin of longitudinal strength. The most critical longitudinal bending in a fully loaded ship is a sagging one, and causes longitudinal compressive stresses at the upper deck; in resisting such stresses the stiffening and strengthening effect of longitudinally disposed deck beams, as in the Isherwood system, is most desirable in every way.

In the design of an oil tanker, it is very important to avoid any possible risk of explosion. Oil itself does not burn, but the gases which rise from its surface do, and when mixed with air in suitable proportions explode violently when exposed to a naked light. Fuel oil is quite safe below 185° F., but at higher temperature it gives off inflammable gases which would ignite if exposed to a naked flame. This critical temperature varies with different oils and is termed the "Flash point."

### Gas Dangers of Unloading

The most dangerous time in operating oil-tank steamers occurs when an oil tank has just been pumped out, for the vapor that arises from the large inside surfaces damp with oil may form a highly explosive mixture.

An oil cargo is a very exacting one and it is of the utmost importance that special care should be taken in the riveting of the vessel. Even when the ship is at rest the intensity of the pressure tends to burst the bulkheads, sides and decks forming the top of the tanks, while at sea this pressure is enormously increased by the rolling and pitching of the vessel. It is the framework that gives the counteracting resistance, and all pressures must be conveyed to it through the rivets; this places them in tension, and tends to slacken them and pull off their heads and points. The number of rivets, therefore, must be increased by a closer spacing than is necessary for water-tight results. Oil is very searching, and all rivets must be perfectly sound.

A bulk-oil steamer requires extensive pumping arrangements, in order to pump out the oil quickly when her destination is reached. This cannot be done satisfactorily from the shore, as a pump will not work efficiently with a lift greater than 18 to 20 ft. Therefore powerful pumps are installed in the ship, as low down as possible in order to minimize the lift and expedite the flow. These pumps are placed in the pump room as described, because leakage from valves and lack of space prevent their being installed in the engine room. As the propelling machinery in oil tankers, which is usually of the reciprocating type, is placed aft, this space is always taken up by the engines and other auxiliaries alone, and danger by leakage and vapor from the pump room is guarded against by large ventilators. The following system is usually adopted for pumping oil:

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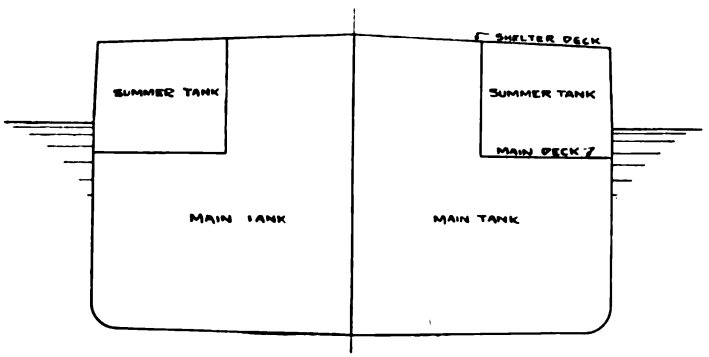
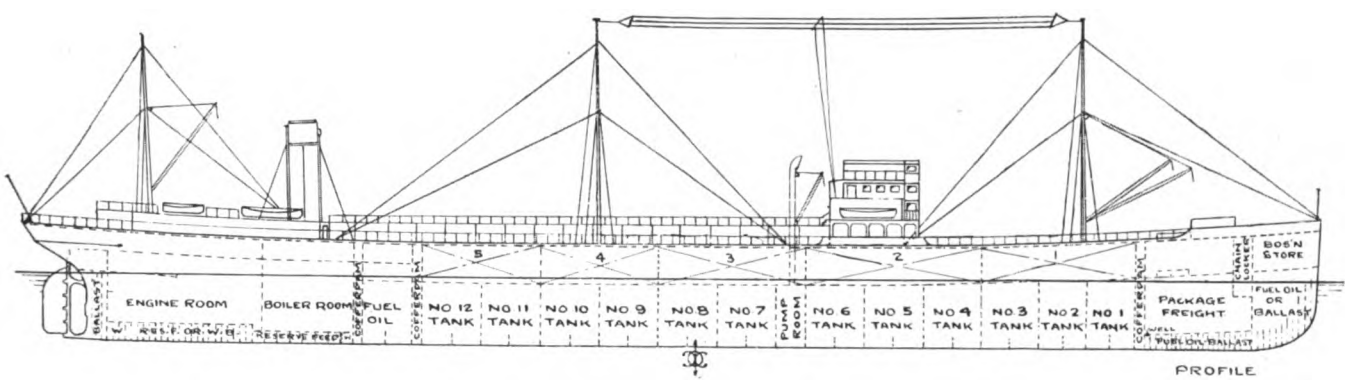
At the bottom of the tanks there are two large pipe lines, one running fore and aft on each side of the vessel. The pipes, which are from 12 to 14 in. in diameter, extend from Nos. 1 to 12 tanks and are connected by a cross-over pipe running athwartships in Nos. 1 and 12 tanks. There are similar cross-over pipes at the forward and after ends of the pump room. Along the whole length of pipe line, therefore, there are four different cross-over lines which can be drawn upon or used to pump from one line to the other, and also branch pipes into each tank from the main line of piping. These are the suction pipes, which suck the oil from the tanks into the pipe lines and through them to the pumps, from which it is delivered to the pipe lines on deck and discharged by these lines overboard. All suctions are at the after end of each tank and are operated by valves worked from the deck. In addition to the piping in the bottom of the tanks, there are fitted "heater coils." As a vessel comes into colder water, the temperature in the tanks decreases, contracting the oil, which thereby becomes thicker, into a smaller space, and making much harder work for the pumps, which always work more easily when the oil is thin. The temperature of the oils is kept up by steam circulating through the heater coils in the bottom of the cargo tanks.

The summer tanks run fore and aft below the full length of the main tanks. This summer-tank space is divided by transverse bulkheads into five compartments which are usually numbered from forward, as in the case of the main cargo tanks. The filling and emptying of these tanks is a very simple matter, for they are all controlled by drop valves, operated from the deck, which admit the oil into the summer tanks from the main oil tanks. In emptying they are simply drained into the tanks below. This method saves a great deal of pumping, but is applicable only where the same grade of oil is carried in both the summer tanks and the main cargo tanks. When different grades of oil are carried, the pumping in the summer tanks is done by pipe lines and valves operated from the deck, as in the case of the main tanks.



MIDSHIP SECTION



MODERN 15,000-TON TANK SHIP.

As it is most essential that the exact quantity of oil in the tank be known, calibration tables are prepared during the construction of the vessel. In order to determine the correct cubic space in measuring a tank, everything within it that takes up space must be deducted, as, for instance, pipe lines, steam coils, valve spindles and all steel work entering into the vessel's structure; with these deductions, the calibration tables give the amount of oil in gallons or barrels for any depth of tank. When the ullage is applied to the calibration tables, the amount of oil in the tank, or the amount that has been taken out, can be seen at a glance. To be correct, these measurements should be taken when the ship is on an even keel, as any list of the vessel may make a considerable difference in the capacity of the tank.

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## Gelasio Caetani

PRINCE GELASIO CAETANI, Duke of Sermoneta and a member of the Chamber of Deputies, has been appointed Italian Ambassador at Washington. His American friends, who are many, know him just as "Gelasio Caetani."

At the outbreak of the war, Caetani returned to Italy, and was made a captain in the First Regiment, Royal Engineers. Before the end of the war he was a colonel. He achieved fame by a notable exploit carried out through practical knowledge gained in engineering studies in the United States—he laid the mine that blew up the whole top of the mountain Col di Lana, from which the Austrians were threatening the Italian lines, which destroyed an Austrian fort and opened the way for the Italian army through the Cordevole Pass in the upper Trentino. He used one of Brunton's compasses in driving these tunnels.

Throughout the war, Caetani distinguished himself and was three times decorated for bravery. After the conclusion of peace he dedicated himself to the redemption of the marsh land between Rome and Naples, where his family possesses large estates.

Caetani, in the last electoral campaign, was chosen a deputy on the Nationalist ticket. He was one of the first of the Roman nobles to embrace the Fascismo—in fact, he is said to have enrolled himself among the original 90 Fascisti organized as a Roman cohort in 1920. His family is one of the noted ones of the Roman aristocracy. A few years ago he succeeded to the title, as head of the house.

He was graduated from the School of Mines of Columbia University in 1903, and went West and made his mark in ore dressing, working his way to the front by sheer ability. He worked as a miner, trammer, timberman, and millhand at Stratton's Independence mine in Colorado, at the Treadwell in Alaska, and at the Bunker Hill in Idaho. He carried through some important problems for the Bunker Hill & Sullivan Co. and later opened offices in San Francisco as a consultant and became a member of the firm of Burch, Caetani & Hershey. Born in 1877, he is now in the prime of life and is noted for his many useful activities.

When the news of this appointment was received, Colonel Dwight, as president of the Institute, cabled Caetani as follows:

Morning papers announce your appointment as Ambassador to United States. On behalf of the American Institute of Mining and Metallurgical Engineers, I desire to express the pride felt by your former professional associates in America in the distinguished record you have made since you departed at the call of your country, and their pleasure at this new honor which involves another sojourn among us. We would like your permission to arrange to signalize your arrival in this country by a dinner in your honor by the Engineering Societies to be held in New York soon after your arrival at a date convenient to you.

The following reply has been received:

Joyfully returning to States which have been my second home. Ready to devote myself for the good of both countries. I am looking forward with intense pleasure meeting old friends at dinner kindly offered. Expect arrive December twentieth.

Caetani's many friends are looking forward to this reunion and are particularly gratified that Italy will be represented in this country by an ambassador who understands it and its people and problems so completely and is withal an engineer.

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## Exchange Professor from France

PROFESSOR Emanuel de Margerie is lecturing at Columbia University, on France's contribution to cartography and geology during the last hundred years. After a month at Columbia, Professor de Margerie will go to Harvard, University of Pennsylvania, Cornell and Johns Hopkins, to spend a month at each university.

Professor de Margerie comes from the University of Strasburg. He is taking an active part in the reorganization of that university. He is also director of the Geological Survey of the Provinces of Alsace and Lorraine, and recently studied in detail the Saar coal basin. He is the author of a great work on the Jura Mountains in France, which is now in press.

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## Government and Business

THE head of an important West Virginia coal-mining company, replying to a recent request for coöperation through suggestion and recommendation with the fuel division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, concluded with this statement:

"We sincerely believe the greatest possible service to the trade within your power is to get out, take as many as possible out with you and stay out. We consider an unmitigated curse the paternalism into which the Government is endeavoring to translate the supervision adopted during the war.

"In our opinion, the paramount duty of the Government at present is to discontinue all its unnecessary functions with a view to reducing expenses and consequently taxes. We believe we can conservatively estimate that at least 75 per cent. of the present government bureaus are unnecessary. The fact that you are circularizing the trade for suggestions of work to enable you to keep your department busy indicates that at least a part of your section is in the 'total loss' class."—*Boston News Bureau.*

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## Winter Mining Session

THE College of Mines, University of Washington, Seattle, will hold its 27th winter mining session from Jan. 4 to March 21, 1923. Anyone who can read and write English may enroll. There will be instruction in quartz mining, placer mining, coal mining, and ceramics. Full details may be obtained from the college.

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# Industrial Relations at Tennessee Copper Company

By J. N. HOUSER

General Manager, Tennessee Copper Co., Copperhill, Tenn.

THE industrial relations between the Tennessee Copper Co. and its employees have developed a number of interesting things and have been most profitable to the employees and to the company. It is noteworthy that considerable has been done without a formal organization of any kind built up through the efforts of the company. From time to time there have been discussions regarding the advisability of a formal organization and the decision has always been in favor of the present method.

In the year 1919, the company was dealing with its employees through union committees and, after an understanding was reached, satisfactory results began to be obtained, but as time went on the committees did not function and it came to a question of how to reach the men. For the past two years, about once a month, but at no stated time, there has been a meeting with a committee of employees consisting of 40 or 50 men out of 700. This committee is secured by notifying the locals. In addition, the Service Department notifies a number of men not represented in the union, so as to have a large representative committee. The meetings are on company time and the men are rotated, so that in time every employee attends at least one meeting. All department heads and a number of foremen also are present. The operating plans and policy of the company are set out at the meetings and the market outlook for products is discussed. Explanations are also given of anything that has come up since the last meeting which affects the employees, and an effort is made to inform them of what will probably happen in the next month or two. Once a week there is a meeting of department heads with the manager, for discussion of all operations as a whole and such departmental details as seem advisable.

When the depression started, it was necessary to curtail operations and the reasons were carefully explained; before the men were laid off, the employees as a whole were advised of the coming layoffs through these meetings. They were also advised generally who would be retained and given an opportunity to express their agreement or their disapproval. In fact, an effort was and is being made to keep the employees advised in advance of matters affecting them and to give them full opportunity to express themselves.

It has been found valuable to have at these meetings as many foremen and department heads as possible, in addition to what might be called "plant labor," and to outline as much of the plans and policies of the industry as is possible, so that when the department heads, foremen and men start to execute these plans, they have a common understanding on which to proceed.

When the recent depression began it was apparent that there would have to be a material decrease in the scale of operations. It was necessary: (1) To consider operating the plant so that expenses might be paid and if possible a profit secured; (2) To maintain, as nearly as possible, a wage commensurate with the still existing high living expense; (3) On account of the isolated location, to provide work for as many men as possible.

### Employees Informed of Changing Conditions

This was worked out by determining the minimum number of men to be employed in actual operations and, depending on the results from operations, to arrive at the amount of work that could be carried on in addition in the way of improvements and maintenance, thus employing additional men. It was necessary to eliminate a number of jobs and to increase the duties of a number of men on other jobs, but first of all it was vital to get the sympathy of the men. This was accomplished by telling them exactly what we thought had to be done. There were misunderstandings, of course, from time to time, and some hard feeling, but on the whole there were no real difficulties. The best men were kept on the work and a tremendous increase was made in all-round efficiency. It is most gratifying to know that during 1920, when labor conditions were very bad, the efficiency of labor at the plant of the Tennessee Copper Co. showed almost continual improvement from month to month, and that that improvement has been continued to the present time.

There has been no philanthropy, paternalism, or formal organization, but merely an attempt, through large gatherings, to keep employees informed of changing conditions and of what appeared to be necessary to maintain the best wage scale possible. No attempt has been made to obtain labor at what might be termed the going rate; on the other hand, we have tried to obtain the maximum amount of work per shift per

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man and to pay all the business would stand. From time to time suggestions have been made to the men of various schemes such as bonus, insurance, etc., and little or no interest has been shown; it was apparent that what the men wanted was the highest daily wage possible without any trimmings, and as a whole they have been willing to give in turn a large amount of work.

### Work of Service Department

There is a Service Department through which men are hired and released. This department looks after the rental and maintenance of houses, injuries, safety work and in general takes care of all the many little things affecting the men in their work and life, and the policy of this department is to represent the men rather than the company. When a department wants a man, a requisition is sent to the Service Department, but the operating department may, if it desires, designate the man it wants, and if his record is clear, that man will be supplied by the Service Department. A department is at liberty to discharge a man for sufficient cause, but discharge must be approved by the Service Department. It has seldom been necessary for the Service Department to insist that a man be retained after being discharged. The mere fact that the department heads and foremen know that discharges are scrutinized makes them careful in using them.

When the Service Department was inaugurated, it was found that one of the greatest sources of discontent on the job was that so many men were discharged without the real reasons being given them or marked on their tickets, but since its establishment there has been a rigid rule that whenever a man is discharged he must be told the reason.

From time to time groups of foremen and employees have been sent out at company expense to industrial meetings where they have had opportunity to hear discussions of industrial difficulties and learn what is being done to improve conditions. These have tended to convince all concerned that on the part of some employers at least an earnest effort is being made to conduct operations with good wages and working conditions to employees, and profit to the owners, and that in order to achieve these ends it was first necessary to have a thorough understanding between employer and employee and then to work out the details.

In starting this work at Copperhill, at first there appeared a disposition on both sides to feel that the other side was attempting to get something for nothing, but after this feeling was overcome and an understanding with confidence was reached, there was little difficulty in carrying out plans for conducting the work in the most economical way.

While conditions beyond our control have prevented the realization of profits that are due the business, the cost of labor per pound of copper and per ton of acid has shown a continuous decrease and there has been a gratifying decrease in the consumption of materials; the small scale of operations made necessary by business conditions has prevented the attainment of still better results which the men on the plant can readily reach. We feel that the good results already accomplished are due to the complete understanding between employee and employer reached by a free exchange of ideas in frequent meetings.

In dealing with a body of men it must not be assumed that a condition of stability can be reached any more than it is possible to secure stability in other factors entering into the business. It is only natural for both employee and employer to expect improvements from time to time and even insist upon impossible things, but if there is the proper understanding of the ideas and aims of both sides, these situations can be taken care of as they arise.

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## Nickel Production and Consumption

THE nickel business of the United States and Canada is practically a monopoly of the International Nickel Co. The *Wall Street Journal* recently gave a summary of the present status of production and consumption.

The company is now selling about 1,500,000 lb. of nickel and 400,000 to 500,000 lb. of monel metal monthly, but nickel sales must reach at least 2,000,000 lb. to cover expenses fully. Output before the war was 3,000,000 to 4,000,000 lb. a month. During the war it reached 8,000,000 lb. monthly. International disarmament programs took away over night a large percentage of the potential uses of the metal and brought about demoralization in the industry.

Heretofore the company has been in position to sell its raw products to a market waiting to receive them, but the future suggests greater activities in fabrication of nickel products; taking nickel which sells in the market at 34 to 35 c. per lb. and converting it into finished products at a cost of a few cents to be sold through more intensive salesmanship and popularization methods at many times the price of the raw product. Evidences of the extent to which this policy is being pursued are seen in the new $3,500,000 mills at Huntington, W. Va., completed this year for the rolling of monel metal.

The company has recently resumed operations on a small scale at its Creighton mine and Copper Cliff blast furnaces, and the refinery at Port Colborne is working at capacity.

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**I hold every man a debtor** to his profession, from the which, as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves, by way of amends, to be a help and ornament thereunto.—Bacon.

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# Recent Negotiations of Russo-Asiatic With Soviet Government

AT A MEETING of the Shareholders of the Russo-Asiatic Cons. Ltd., in London, Oct. 23, 1922, LESLIE URQUHART, chairman of the company made the following statement:*

I come now to our recent negotiations with the Soviet Government and to the agreement which has resulted from them. You will remember that the conference at The Hague broke up without having achieved anything very definite. It was not, however, a failure. It elicited from M. Litvinoff an offer which will, I think, come to be regarded as a milestone in the progress of Russia from a ruinous and unpracticable Communism towards a modified form of capitalism. The offer made by M. Litvinoff at The Hague amounted in effect to this: that in return for political recognition on our part the Soviet Government would first acknowledge its liability for Russia's national foreign debts, and, secondly, would give the original foreign owners of property in Russia effective compensation. A very great advance that. It showed—and there have been many other signs to confirm it—how real and persistent has been the internal evolution of Russia during the past year from Marxism to the economics of the Western world.

I will not now detain you with the reasons why M. Litvinoff's highly promising and significant offer came to nothing. The fact that it had been made and the further fact that The Hague Conference had separated indefinitely were the important things. The first fact seemed to indicate that the Soviet rulers, after all, proved to be people with whom one could do business. The second fact rather emphatically showed that the way to do business with them was not by unwieldy polyglot conferences of ministers, officials and experts representing a few dozen different governments and a few dozen different sets of national interests. That method had been tried at Genoa. It was tried again at The Hague. Each time it failed, and having failed it left the road clear for a simpler and more direct approach.

I hope you will agree that the course pursued by us as a Board was the right course. We supported and did everything we could to assist the Government in trying to make the conferences a success. When success was seen to be unobtainable, we then, and only then, decided, at the suggestion of the Soviet authority, to resume negotiations on our own account. We felt confident of finding them in a more tractable mood than they were a year and a half ago, when, as you will recall, our attempt to reconcile Communistic theories with business realities proved a failure. But a great deal has happened in Russia since then, and it has all been in the direction of convincing the rulers of the country that nothing but ruin resulted from a system under which the state owned everything and tried to manage everything itself; that Russia desperately needed foreign capital, and that foreign capital would never think of coming in so long as the Russian Government repudiated Russia's debts and imagined it could seize and nationalize anything and everything that did not belong to it without paying a penny of compensation.

What I believe is thoroughly understood in Moscow today is that this way of doing things is simply not practicable. Experience has absolutely riddled Communism as a possible economic system. For all the practical purposes of life and affairs the great experiment is recognized as a catastrophe from the entanglements of which all Russia, with such strength as is still left in her, is struggling to escape. All this, of course, was well known to us on the Board. We believed that a process of enlightenment and evolution of this character, once begun, could not be stopped, and that it was bound to go forward until the rights of property, the freedom of private enterprises and the duty of meeting national obligations were admitted and acted upon in all departments of Russian life. We, therefore, felt no hesitation—and here I count confidently on your approval—in accepting the invitation of the Soviet authorities to resume negotiations.

### FEATURES OF THE AGREEMENT

The agreement which was ultimately reached had one or two features in it to which I should like to draw your attention. In the first place, there was not a line, not a word, not a syllable of politics in it from the beginning to the end. We put all such considerations on one side and devoted ourselves, simply as business men, to framing a business contract. In the second place, the agreement gave us all that we could reasonably ask for. I have not a word of criticism as to the way in which we were met by Mr. Krassin and his colleagues. They were keen but straightforward bargainers, and I was particularly glad to observe that they cordially recognized the immense importance of our undertakings to Russia's industrial welfare and their complete identification with the interests of the Russian people. We are not only the biggest foreign enterprise in the country, but all our work there

* Reprinted from the *Financial Times* of Oct. 24.

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is constructive and of immediate and tangible benefit to the nation. This was freely and generously admitted, and I hope that in return the Soviet delegates found in me one who, while determined to safeguard the rights of this company, appreciated their difficulties and was sincerely anxious to help them.

It is hardly necessary for me to go into the details of the agreement, the general terms of which have been conveyed to you in the directors' report. All I need say on behalf of myself and my colleagues is that we consider it a very fair arrangement for both sides.

In my judgment—and I hope and believe you will agree with me—it provides a good working basis on which we should be justified in resuming operations in Russia. Given good faith on both sides—for that, after all, is the essence of any agreement—I felt that at last we had found a starting point for active business development. The agreement was fair to us; it was manifestly advantageous to Russia; once ratified and in operation it would become the forerunner of foreign enterprise in Russia and make the country once more an investment possibility. I might mention in this connection that certain negotiations had taken place between myself and M. Stomaniskoff, the Soviet representative at Berlin, with a view to the formation of a large trading organization, in which the Soviet Government would have had an interest. Long credits on good terms for materials and goods had been offered to our organization by large British manufacturing firms totalling several million pounds sterling. This scheme is now also in abeyance.

### Still in Suspense

But, as you are all aware, the agreement was not ratified; it is still in suspense. It failed to secure the necessary endorsement for reasons that had nothing whatever to do with its business aspects. They were political reasons, and they were set forth in a document (given in the directors' report in your hands) that must always rank as a curiosity among state papers. This document began by proclaiming the "extreme desirability" of getting foreign capital to help in the reconstruction of Russia. It went on to lay stress on the particular desirability of an agreement with the Russo-Asiatic Consolidated. But it held that before any such agreement could take effect there ought to be "friendly, stable and regulated relations" between the Soviet Republic and the British Government. Such relations, it proceeded to argue, did not at present exist. On the contrary, it charged the British Government with the intention of denying to Russia an equal right with other nations in settling the Near Eastern and the Black Sea questions. Therefore, this amazing document concluded, the ratification of the agreement ought to be withheld.

I do not think I exaggerate when I say that this announcement came as a shock to the whole world. It mixed up politics with business in a way business men have no patience with and will never tolerate. It seemed to justify all the doubters who maintain that the rulers of Russia are theorists, without any business sense or knowledge. Every enemy of Soviet Russia was delighted, and every friend was cast down by the puerile irresponsibility of the Russian Government's conduct.

### Political Recognition

But besides all this, the terms in which the non-ratification of the agreement was proclaimed showed a pathetic ignorance of the British system and of the British mentality. It was clearly the calculation of M. Lenin and his advisers that commercial opinion in Great Britain would be so startled and disappointed by what had taken place that it would at once put pressure upon the Foreign Office to give the rulers of Russia what they want—namely, political recognition. They evidently regard Great Britain as a capitalist country and the Foreign Office as the diplomatic instrument of the big business interests, and they have so little knowledge of British psychology as to think that we can be bullied or badgered into adopting a policy which on its merits we have rejected.

Now, personally, I think we ought to give full and public recognition—we have already given half-recognition through the Trading Agreement—to the Soviet régime. It has lasted now five years; there is no likelihood of its being ousted, but every chance of its becoming more practical. The friendship of Russia is of immense future importance to British interests, and I cannot see what we gain by taking up an attitude of moral superiority to an established government, and treating it as a pariah. Personally, also, I feel that Russia ought to be, and I am confident she will be, given an equal voice in the discussion of those Near Eastern questions which so closely touch her and I should like to see our Government taking the initiative in inviting her presence at the forthcoming conference.

### Advice to the Russian Government

But even if I had the power to press these views upon the directors of British policy, I should refuse to do so as the price of having our agreement ratified. I am not going to mix politics with business. When the agreement is ratified and a closer and friendlier relationship with the Russian Government is thereby made possible, other developments of a more definitely political character will inevitably follow, and these developments, I am sure, we shall all be glad to do what we can to hasten. But until the agreement is ratified my hands and the hands of every British well-wisher of the Russian people are completely tied.

My advice to the Russian Government, if it really wishes, as I am sure it does, to attract foreign capital and to be treated as an equal by other governments, is

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simply this: "Ratify the agreement and show that you have been sincere and consistent in your policy at Genoa and at The Hague. Announce your readiness to recognize Russia's national debts and to do justice to those foreign owners whose property has been nationalized. When that is done full political recognition must surely follow."

My very strong belief is that Moscow already understands the blunder it has made, and that the agreement will before very long be duly ratified. There is simply no other way in which the Soviet rulers can now hope to win the confidence of the British investing public and to undo the harm that has been done by an act of precipitate stupidity. From other governments they have nothing to hope in the way of financial assistance. But there is no reason why they should look to any government for the means to set Russia on her feet again. If they get the goodwill and the confidence of the investing public in Great Britain, France and the United States, and even Germany, they will be in possession of resources infinitely greater than any government can provide. But to do this they must act sensibly and straightforwardly and not play fast and loose with an agreement on which the attention of business men in all countries has been focussed. It follows, of course, that until the agreement is ratified our claim of £56,000,000 against the Russian Government remains in force and unabridged, and will, as a matter of course, be vigorously pressed.

### Valuable Records

In conclusion, let me say that the immense value of the industries we have created in Russia is not in the extent and richness of our ore deposits, nor in their technical equipment alone. We have the accumulated records of many years of scientific study of different mineralized formations and the tabulated results of skilled geological research. During some 25 years' work in the Caucasus, the Urals, Central Asia and Siberia, the pioneers of our group and our present technical organization, after careful investigation, turned down more than one-thousand mining prospects and propositions.

We have the complete records of over 100,000 ft. of diamond drilling, proving our mineral reserves and giving us the metal contents of the ores underground, without which controlling data underground mining and extraction would be blind.

We have in our possession the detailed results of many years of delicate research work in solving the metallurgical problems we were up against, and finally we have evolved, developed and operated, with complete commercial success, special processes and methods of treatment adapted to the peculiar character of the different complex and refractory ores of copper, lead, zinc, gold and silver which we have proved up.

Without this knowledge the equipment and, indeed, the properties themselves, are of secondary value, as has been shown by the Soviet Government's futile efforts to operate them. It has taken our technical organization of British and American engineers and metallurgists 15 years of hard and intelligent work and the expenditure of many hundreds of thousands of pounds of British money to collect this vital knowledge and experience which went to build up and operate our great mining and metallurgical enterprise. This knowledge, without which the enterprise cannot be operated successfully, is ours and ours alone, and is in our sole possession; no one—whether Communist or capitalist government—can nationalize it without our approval.

We are willing to use this accumulated knowledge and experience for the successful operation of our properties when they are returned to us, but we do not propose to give it away.

Finally, while I do not wish to give you too optimistic an impression, it is right that we should have a fair conception of our position. Our properties are in the richest country in the world so far as natural resources are concerned. We have suffered from temporary decrees and laws of the Soviet Government, but laws of nature are natural laws and above those made by human kind. Natural laws have forced the Government of Russia to cede to the economic requirements of the peasant population against their Communistic theories. It is essential for the 90 per cent. peasant population of Russia to have now organizations such as ours to bring the dormant natural riches to the aid of industry and the economic life of the country, and this necessity has been recognized by M. Lenin and other leaders in the government, and is the reason for the contract we have just signed. I have therefore a certainty of conviction and very good reasons for my belief that the time is now very near when we shall be called back to work for the benefit of Russia and of ourselves as shareholders in this corporation.

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## Investigation of the Herschel Type of Weir*

By Richard H. Morris and Albert J. R. Houston

THE great multiplicity of weir types and the corresponding multiplicity of weir formulas early led Mr. Clemens Herschel to believe that the problem of measuring large quantities of water was being attacked from the wrong angle. As early as 1898, in an article in *Engineering News* for Nov. 10 of that year, he protested against the usual method of making weir observations and suggested that the measurements be taken at the crest. When the American Society of Mechanical Engineers appointed a committee to draft a revised form of Power Test Code in 1917, Mr. Herschel was made a member and the Engineering Foundation

* From abridgment of paper awarded the A. S. M. E. Student Prize for 1921. *Mechanical Engineering* (October, 1922).

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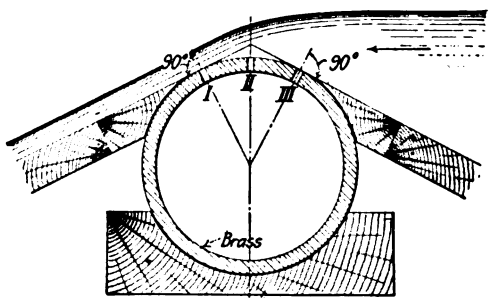
made an appropriation to be expended by him in research work on weirs. In September, 1919, in the Hydraulic Laboratory of the Massachusetts Institute of Technology, he built and tested a weir which he briefly described in an article entitled An Improved Weir for Gaging in Open Channels, as follows:

The fundamental idea followed in the design of the new weir was to have the water to be measured conducted over the weir in a gentle manner, and so as to have it flow smoothly and regularly from the time it first encounters the weir construction until it leaves it. Instead of allowing the body of water to impinge with more or less violence, according to the velocity with which it approaches the weir, against a perpendicular wall in its path (the upstream face of the ordinary weir), it is gently led to the crest by a 2:1 slope. Instead of striking on or being torn over a




DETAIL OF CREST OF HERSCHEL-TYPE WEIR.

sharp edge at the crest, the crest is made in the form of an arc of a circle; and instead of bothering about air under the nappe, the nappe is supported on another 2:1 slope downstream from the crest. Moreover, the crest is made hollow so that observations of the pressure or lack of full pressure, whichever the water may elect to exercise, can be taken at the crest, not at a distance upstream from the crest, at a distance varying according to the fancy of the experimenter.

If the quantity passing over the weir turn out to be a function of this observed pressure, well and good. If not, we will see what virtue there is in the difference of water elevations or pressures, the one taken upstream from the weir and the other taken by means of the hollow weir crest.

The difference referred to above proved to be the sought-for solution of the problem at hand . . . A United States patent has been applied for covering the weir construction herein described.

Our weir crest had a radius of 0.198 ft., and the outside surface was hard and smooth oil paint.

The results of this test were presented to the American Society of Mechanical Engineers at their Spring Meeting in May, 1920, an abstract of the paper having been published in *Mechanical Engineering* for February of the same year. Mr. Herschel's tests showed that for discharges of from 0 to 9.55 cu. ft. per sec. per ft. of weir length (the limits covered by the experiments) the quantity of water flowing, $Q$, was directly proportional to the difference, $d$, in two pressures, one measured just upstream from the weir, and the other measured at the crest, the formula being $Q = 5.50\ d$.

The work herein described constitutes an investigation of a Herschel-type weir from six distinct points of view. First, an attempt was made to check the work of Mr. Herschel. Next, it was desired to find the effect on the action of the weir of the following five modifications in its construction:

1. The degree of smoothness of the crest and slopes.
2. The radius of the crest.
3. The position at which the upstream measurement is made.
4. Increasing or decreasing the velocity of approach.
5. Changing the position of the orifices in the crest.

Undeniably, the work should have included an investigation of the effect of different slopes. However, neither time nor funds were available for such extensive work as this would require.

## SUMMARY AND CONCLUSIONS

From an examination of the curves it is evident that all the factors mentioned earlier in the paper affect the discharge to some extent. The discharge constant varies over a wide range, depending upon conditions.

Friction greatly affects the discharge of this type of weir and this variation may be as great as 12 per cent. This is a disadvantage and will have a bearing upon the change of slope, the effect being proportional to some function of the velocity—probably the square. Friction and contraction are the two limiting factors of the discharge, and from Bazin's experiments it seems that a 2:1 slope represents the point where the combined effect is about a minimum and the discharge a maximum. In order to offer a basis of comparison, it would be well if future experimenters would do their work with surfaces that are capable of fairly accurate reproduction, such as cement, hardwood flooring or germanstone.

The formula for the discharge is materially affected by the size of the pipe forming the crest.

The particular curves of the small crest seem to indicate that each size of crest has definite limits between which the discharge varies as a straight-line function.

Upstream measurements taken with three gages were identical below about 3½ cu. ft. per sec. per ft. length of crest. Above that quantity the gage nearest the crest showed a slight drop, indicating that the upper-surface curve extended at least 6 ft. upstream from the crest.

That the velocity of approach cannot be corrected for by means of the simple formula $V^2/2g$ is shown ($V$ = velocity; $g$ = gravitational constant).

The most important factor is the position of the orifices in the crest. The discharge is a straight line-function only when the holes are normal to the upstream slope, or nearly so.

The results of this investigation tend to show that when a weir of the Herschel type is properly constructed there is a constant ratio between the quantity of water passing over the weir and the difference in the two observed pressures. However, so many are the determinant factors and so great in their influence upon the discharge formula that a weir of this type, in its present state of development, would probably be valueless unless calibrated by actual tests. It is believed that further extended research may remedy this difficulty. Probably the chief advantage of the new weir lies in the fact that for the same upstream head it discharges about 20 per cent. more water than the ordinary type of weir.

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# Loftus Improved Open-hearth Furnace

By William Millward*

ONE of the 75-ton open-hearth furnaces at the Lowellville Works of the Sharon Steel Hoop Co., burning producer gas, recently was equipped with the new Loftus fuel and air devices and began a successful run on June 6. The furnace demonstrated the practicability of the invention during the remainder of June and produced heats from all cold metal in an average time 3½ hr. less than the average time of the other furnaces. It was necessary to place pipes across the nose of the mixing chambers to protect them from the intense heat of the gas flame.

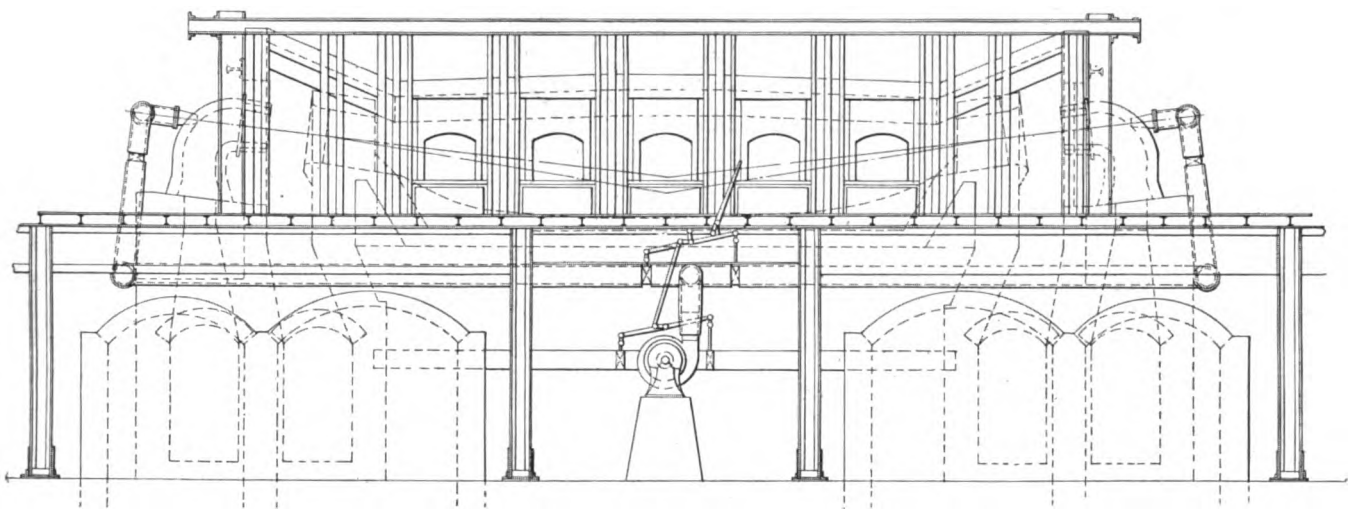

Fig. 1.—General arrangement of Loftus improved furnace.

Figs. 1 and 2 show the general arrangement of the furnace and an enlarged detail. It will be seen that the gas and air rise in the usual way from the slag pockets of their respective regenerators, but that the gas is introduced into the end of the furnace through a goose neck with a water-cooled nose, having a nozzle at the back, for introduction of an air blast which boosts the gas to the desired velocity, so that it will induce the necessary amount of air for combustion from the air uptake into the mixing chamber with it. The air blast, about 10 per cent. of the necessary air for combustion, incidentally dilutes the gas with oxygen so that the subsequent combustion is more rapid.

A blower is provided in the cellar between the regenerators, driven by a variable-speed motor. This blower draws air from either regenerator through the intake pipe. At the junction of the intake pipes from the two sides, an opening or mixer is provided to admit atmospheric air in such quantity as to reduce the temperature of air entering the blower to 1000° F. or less, so as not to injure the blower.

The air is discharged into pipes leading to each end of the furnace and the direction of the blast is regulated by the position of four blast gates, two in the intake pipes and two in the discharge, all of which are operated by one lever situated near the stack with the other reversing and operating controllers. The discharge pipe may be covered with insulating material to retain the temperature of the air, though the need of it is unimportant in actual operation save for the small gain in the thermal efficiency of the furnace.

The blast is introduced into the gas goose neck in the direction of the flow of the gas at any desired velocity, within the range of the blower, through the nozzle at the back, and the gas is thus boosted to the velocity necessary to induce the air from the air uptake into the mixing chamber. The velocity is governed by the size of this nozzle, which may be restricted by the introduction of an inner nozzle of the desired size and shape.

An oval orifice for the mixing chamber is preferable so that the flame may be comparatively wide and shallow. The orifice in the goose neck is made with its contour parallel to that in the mixing chamber to get the best induction.

The point of desired combustion with a given gas depends on the degree to which the gas is diluted with oxygen in the goose neck, the prompt mixing with the air from the air uptake and, of course, the temperature of all. Combustion may be delayed somewhat by drawing waste gases from the outgoing regenerator, mixed with atmospheric air to cool them, into the blower, so that the air blast will contain less oxygen; the amount of oxygen may be regulated also by the temperature of the air blast.

The flame in the furnace is made as short or as long as desired by the speed of the blower and by the use of the usual regulating valves for gas and air inlets. If desired, as in heating furnaces, to attain complete combustion upon entering the hearth, the flame is shortened so as to be practically invisible, but for melting purposes this is not practical, as the melting is best carried on by the cutting action of the flame and

* Consulting Engineer, Pittsburgh, Pa.

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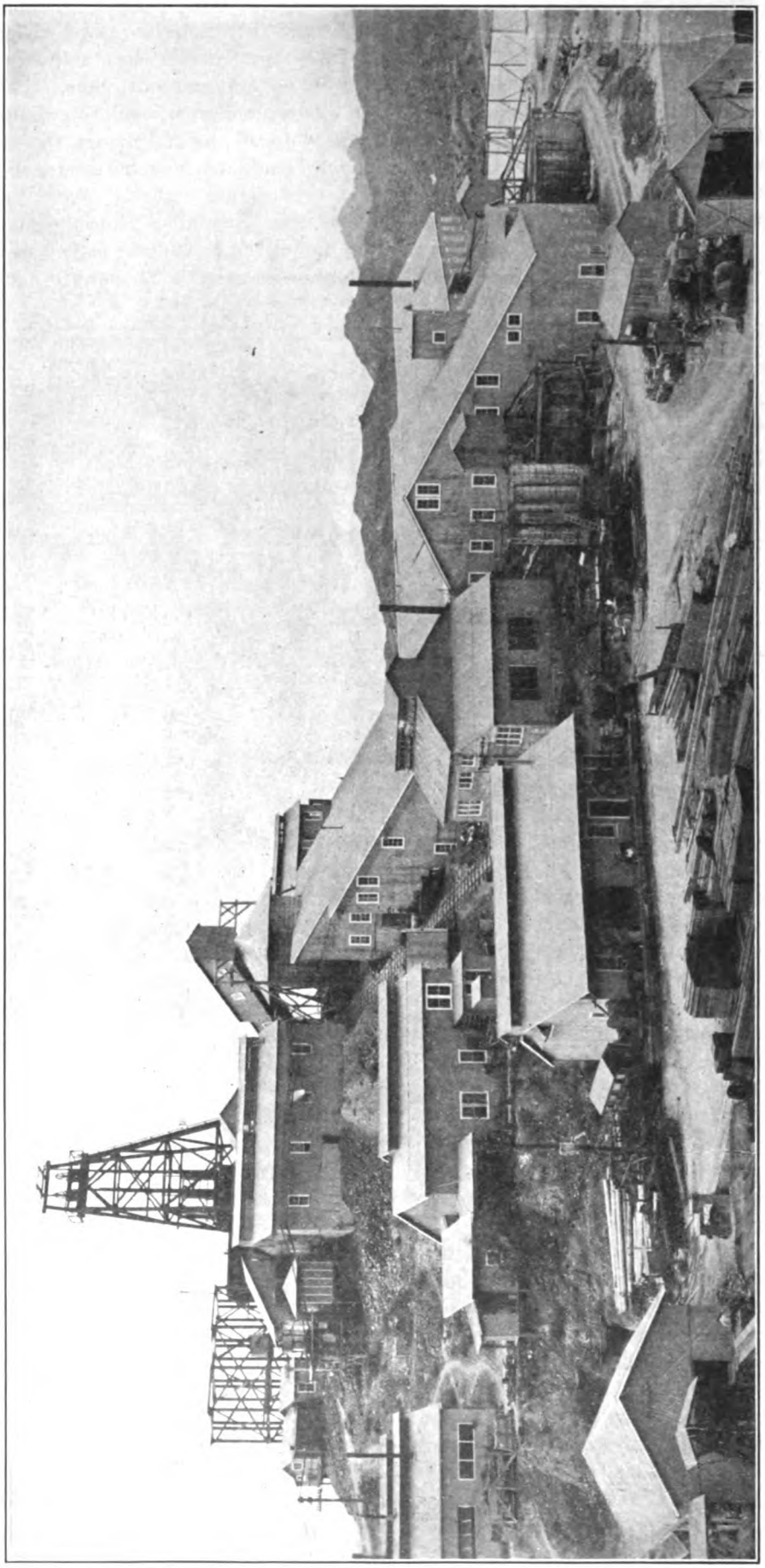

UNITED EASTERN MILL AND SURFACE PLANT, OATMAN, ARIZONA.

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the flame must have body to cut the metal. The rate of transmission of heat from the gas to the metal by convection increases with the velocity of the gas flame. While the air and gas are forced into the hearth through the mixing chamber, they pass out through the opposite mixing chamber and the space between the block and the roof, so that the furnace clears itself well and the flame travels close to the metal through the center of the furnace and away from the roof and side walls. The result is a sharp hot working furnace showing much speed without any tendency to destroy front and back walls and roof, with an easily controlled flame with good cutting action and without harmful oxidation.

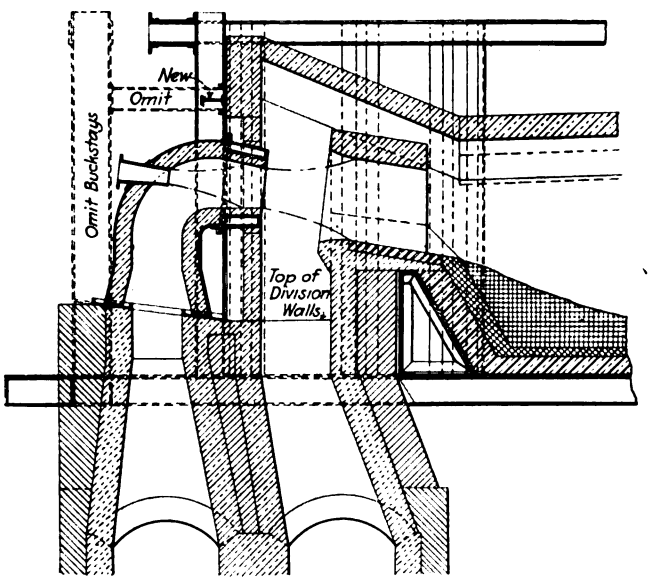


FIG. 2.—HEARTH PORT, LOFTUS EQUIPMENT FOR 75-TON OPEN-HEARTH FURNACE.

The usual condition in the ordinary furnaces with ports is that the velocity with which the gas is introduced into the furnace is governed by the pressure on the producer, the degree to which the gas inlet valve is opened and the pull of the stack. The air is introduced beside and over the gas port at the velocity afforded by regulation of an air inlet valve augmented by the temperature of the regenerator and the pull of the stack, and its office is to overtake and burn the gas before the end of the furnace is reached, whereas in the Loftus furnace the air and gas are promptly mixed in the mixing chamber and travel from there together.

## Drinking Water in Mines

DETAILED information regarding the prevention of contamination of drinking water used in mines is given by Dr. R. R. Sayers, chief surgeon of the Bureau of Mines, in *Serial* 2391, which may be obtained from the Bureau of Mines, Washington, D. C.

Where the water is known to be infected or its purity is unknown, it may be made safe for drinking purposes by distillation, by boiling, or by chlorination. Small filters of the household type are not usually satisfactory and their use, therefore, is not advised. The piping of drinking water underground is the safest method of its distribution. If containers, such as barrels or kegs, are used in taking water underground, they should be kept tightly closed with only a tap or drinking fountain head, or both, for withdrawing the water. Such containers should be washed thoroughly and disinfected at regular intervals, at least once each week.

Sanitary drinking fountains should be so designed that it is impossible for the mouth of the drinker to come in contact with the outlet. When ice is used for cooling water, it should be made from distilled water or water from a source approved by the State Department of Health. If the ice and water are not in contact, the purity of the ice is of less importance.

## Mining and Milling Costs of United Eastern Mining Company

THE following detailed figures of mining and milling costs are taken from the 1921 annual report of the United Eastern Mining Co., Oatman, Ariz., which has just been issued. In 1921 the mine production was

ANALYSIS OF INDIRECT COSTS

| | Cost per Ton 1921 | 1920 |
|---|---|---|
| Superintendence | $0.100 | $0.114 |
| Cottage expense | 0.009 | 0.014 |
| Accounting department expense | 0.129 | 0.112 |
| Legal expense | 0.069 | 0.054 |
| Offices expense | 0.024 | 0.024 |
| Taxes | 1.207 | 0.935 |
| Accident expense | 0.041 | 0.306 |
| Fire insurance | 0.036 | 0.034 |
| Miscellaneous | 0.073 | 0.075 |
| Total indirect costs | $1.688 | $1.668 |

PRODUCTION, COSTS, EXTRACTION, ETC

| | Per Ton 1921 | Per Ton 1920 | Per Ton 1919 | Per Ton 1918 |
|---|---|---|---|---|
| Gross value ore milled | $20.229 | $21.703 | $20.874 | $23.158 |
| Loss in tailing | 0.621 | 0.639 | 0.627 | 0.706 |
| Value recovered | $19.608 | $21.064 | $20.247 | $22.452 |
| Operating costs: (exclusive of depletion, depreciation, prepaid development, Federal taxes and litigation expenses) | | | | |
| Mining—direct | $ 4.388 | $ 5.194 | $ 5.086 | $ 4.728 |
| Shaft sinking (No. 2 Shaft) | | 0.020 | 0.142 | |
| Milling—direct | 1.948 | 2.023 | 2.015 | 2.216 |
| Marketing | 0.122 | 0.120 | 0.114 | 0.130 |
| Indirect costs | 1.688 | 1.668 | 1.724 | 1.427 |
| Sinking and development, two shafts | 0.884 | | | |
| Labor, hauling, power and miscellaneous items in cost of erecting tramway, additions to mill, etc. (does not include costs of salvable material or equipment) | 0.467 | | | |
| | $ 9.497 | $ 9.025 | $ 9.081 | $ 8.501 |
| Income from direct operations | $10.111 | $12.039 | $11.166 | $13.951 |
| Add: Miscellaneous income | 0.014 | 0.012 | 0.011 | 0.012 |
| | $10.125 | $12.051 | $11.177 | $13.963 |
| Less: Administrative expense | 0.195 | 0.142 | 0.142 | 0.150 |
| Net income from operations | $ 9.930 | $11.909 | $11.035 | $13.813 |

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97,413 tons, with an average value per ton of $20.26, of which 96.23 per cent. was recovered. In the previous year, 1920, the production was 99,225 tons of ore, having an average value of $21.76, of which 97.95 per cent. was recovered.

ANALYSIS OF MINING COSTS AT NO. 2 SHAFT

FOR THE YEAR 1921

(Based on 95,807 tons produced from No. 2 Shaft workings)

| | Labor | Timber | Explosives | Other Supplies | Power | Miscellaneous | Amount 1921 | Amount 1920 | Cost per Ton 1921 | Cost per Ton 1920 |
|---|---|---|---|---|---|---|---|---|---|---|
| Foreman and shifters | $ 16,145.17 | | | | | | $ 16,145.17 | $ 18,869.60 | $0.169 | $0.190 |
| Stoping | 105,536.22 | $42,456.64 | $23,439.19 | 9,497.97 | $ 9,069.15 | $ 74.14 | 190,073.31 | 261,476.85 | 1.985 | 2.636 |
| Filling | 48,781.31 | 2,589.75 | 14,815.62 | 5,503.34 | 6,957.13 | 4.42 | 78,651.57 | 120,222.74 | 0.821 | 1.212 |
| Development | 11,884.78 | 23.13 | 4,050.41 | 1,241.95 | 1,390.58 | 0.04 | 18,590.89 | 37,902.80 | 0.194 | 0.382 |
| Dead work | 5,740.32 | 776.39 | 328.42 | 220.90 | 331.87 | 1.39 | 7,399.29 | 2,513.54 | 0.077 | 0.025 |
| Diamond drilling | 15,737.49 | 73.52 | 1,083.33 | 5,759.68 | 7,175.63 | 209.88 | 30,039.53 | 14,899.91 | 0.314 | 0.150 |
| Hoisting | 16,680.51 | | | 420.84 | 4,458.22 | 1,372.11 | 22,931.68 | 26,333.85 | 0.239 | 0.265 |
| Dewatering | 2,904.00 | | | 241.98 | 1,535.35 | 14.08 | 4,695.41 | 5,635.41 | 0.049 | 0.057 |
| Assorting ore | 1,335.70 | | | 33.74 | | | 1,369.44 | 1,844.50 | 0.014 | 0.019 |
| Sampling | 191.17 | | | 96.25 | | | 287.42 | 609.43 | 0.003 | 0.006 |
| Assaying | 2,334.22 | | | 962.19 | 507.49 | 12.64 | 3,816.54 | 3,411.41 | 0.040 | 0.034 |
| Engineering | 3,515.71 | | | 466.27 | | 102.03 | 4,084.01 | 2,565.58 | 0.043 | 0.026 |
| Ventilation | 984.62 | | | 706.93 | 5,713.70 | | 7,405.25 | 6,061.11 | 0.077 | 0.061 |
| Miscellaneous | 10,815.06 | | | 3,678.36 | 883.47 | 9,873.48 | 25,250.37 | 26,434.85 | 0.264* | 0.267* |
| Handling dump ore | | | | | | | | 5,708.34 | | 1.542 |
| Direct mining costs, 1921 | $242,766.28 | $45,919.43 | $43,716.97 | $28,830.40 | $38,022.59 | $11,664.21 | $410,919.88 | $534,489.92 | | |
| Cost per ton, 1921 | 2.534 | 0.479 | 0.456 | 0.301 | 0.397 | 0.122 | 4.289 | | $4.289 | |
| Cost per ton, 1920 | 3.222 | 0.620 | 0.560 | 0.264 | 0.288 | 0.240 | | 5.194 | | $5.194 |

* Costs to this point for 1920 are ..... $5.330

* Costs to this point for 1921 are ..... 4.289

$1.041

ANALYSIS OF MILLING COSTS

FOR THE YEAR 1921

| | Labor | Supplies | Power | Miscellaneous | Amount 1921 | Amount 1920 | Cost per Ton 1921 | Cost per Ton 1920 |
|---|---|---|---|---|---|---|---|---|
| General | $10,204.35 | $ 3,207.91 | $ 551.45 | $ 2,655.55 | $ 16,619.26 | $ 17,140.71 | $0.171 | $0.166 |
| Lighting expense | 55.35 | 178.19 | 278.57 | | 512.11 | 362.62 | 0.005 | 0.004 |
| Water supply | 3,928.77 | 2,358.00 | 2,318.20 | 5.58 | 8,610.55 | 10,871.28 | 0.088 | 0.106 |
| Coarse crushing | 2,751.49 | 1,845.97 | 1,139.46 | 0.27 | 5,737.19 | 5,520.26 | 0.059 | 0.054 |
| Coarse grinding | 4,712.65 | 10,318.00 | 17,992.49 | | 33,023.14 | 39,662.54 | 0.339 | 0.385 |
| Fine grinding | 7,173.68 | 15,398.58 | 23,620.95 | | 46,193.21 | 46,575.17 | 0.474 | 0.452 |
| Cyaniding | 8,912.44 | 25,879.27 | 16,598.16 | 0.31 | 51,390.18 | 51,878.23 | 0.528 | 0.503 |
| Tailing disposal | 1,900.50 | 7.72 | | | 1,908.22 | 5,407.46 | 0.020 | 0.053 |
| Clarification | 103.82 | 1,578.84 | 1,032.32 | | 2,714.98 | 3,358.58 | 0.028 | 0.633 |
| Precipitation | 511.25 | 5,497.98 | 2,165.03 | | 8,174.26 | 8,400.10 | 0.084 | 0.082 |
| Refining | 3,054.98 | 4,100.26 | 277.19 | | 7,432.43 | 7,432.54 | 0.076 | 0.072 |
| Sampling | 2.89 | 258.92 | 67.38 | | 329.19 | 155.03 | 0.004 | 0.002 |
| Assaying | 2,334.18 | 962.22 | 507.51 | 12.63 | 3,816.54 | 3,411.52 | 0.039 | 0.033 |
| Retreating tailing | 1,425.67 | 31.05 | | 18.43 | 1,475.15 | 2,184.41 | 0.004 | 0.021 |
| Mill heating | 238.02 | 1,731.08 | | 0.55 | 1,969.65 | 4,156.37 | 0.020 | 0.040 |
| Solution recovery | 208.21 | 69.87 | 512.31 | | 790.39 | 1,755.72 | 0.008 | 0.017 |
| Experimental | 7.99 | 26.14 | | 89.00 | 123.13 | | 0.001 | |
| Total milling, 1921 | $47,526.24 | $73,540.00 | $67,061.02 | $ 2,782.32 | $190,819.58 | | $1.948 | |
| Total milling, 1920 | 52,450.70 | 74,362.86 | 61,734.42 | 19,719.56 | | $208,267.54 | | $2.023 |
| Cost per ton, 1921 | 0.477 | 0.754 | 0.688 | 0.029 | 1.948 | | | |
| Cost per ton, 1920 | 0.509 | 0.722 | 0.600 | 0.192 | 2.023 | | | |

## Special and Stainless Steels in Mining

AT a recent meeting of the Institution of Mining Engineers, at Sheffield, Dr. W. H. Hatfield, discussing a paper on Stainless Steels, suggested that the mining industry has not taken full advantage of metallurgical progress in the development of certain special steels characterized by abnormal strength and resistivity without undue loss of ductility. The normal, mild steels, of course, are employed in large and increasing quantity for mining operations, but some parts of the field seem to be open for the more extended use of these special and more costly steels. Among other possible applications of these steels, Doctor Hatfield mentioned boiler fittings, pump cylinder liners and rods, valves, impellers for centrifugal and rotary pumps, fan blades, pins, links and other parts of conveyers and elevators, parts of weighing machines, and gauze for safety lamps. Springs are already being made from rustless steel, and experiments are being made with hoisting ropes, for which these steels, though expensive, seem to be well adapted under certain conditions.

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# Abstracts of Institute Papers

The following papers will be printed in full in pamphlet form. A copy of any of these papers complete will be sent free to members on application, for which a request blank is furnished on page 24 of the Advertising Section. Discussion of papers is invited.

## Colloid Chemistry and Metallurgy*

By Wilder D. Bancroft, Ithaca, N. Y.

COLLOID chemistry, which may be considered as the chemistry of bubbles, drops, grains, filaments, and films, all things in which at least one dimension is very small or in which the surface is large relatively to the mass. Films, of course, suggest to the metallographist Beilby's amorphous film theory. So far as I can judge from looking over the literature hastily, there are two schools in the United States, those who accept Beilby's theory willingly and those who accept it unwillingly.

If Mathewson represents one extreme, with Hoyt perhaps occupying a middle ground, H. M. Howe may be cited as one of the enthusiastic supporters of Beilby's amorphous theory. Beilby's theory is that polishing or working a metal produces a film of amorphous material on the surface or at the slip planes, amorphous being used in the strict sense as referring to a supercooled liquid. Rosenhain goes further than this and believes that chill-cast metals contain amorphous films. Now, metals have such a high tendency to crystallize that nobody has ever succeeded in getting any of the orthodox ones in the form of a glass. In fact, Rosenhain and Archbutt admit quite frankly that the evidence for the existence of an amorphous film is entirely circumstantial.

In other words, the hypothetical amorphous metal is so instable that there is no hope at present of preparing it in mass and yet it is assumed that the amorphous film persists nearly up to the melting point of gold, for instance. This seems so hopelessly improbable that some people have discarded the hypothesis except for cold-worked metal. I am prepared to go one step further and to reject the amorphous-film theory completely. So far as I can learn, no metallographist has made a serious study of the properties of very small crystals and yet our experience with colloids impresses on us strongly the rather extraordinary apparent changes in properties that occur when a phase is subdivided very much. It seems that the advocates of the amorphous theory have taken whatever properties they needed and have assigned them arbitrarily to the hypothetical amorphous phase.

One must admire the way in which the amorphous-film theory has been built up, apparently without a single fact back of it. The trouble has been that the people who objected to the theory have always stood on the defensive and have accepted the postulates of the upholders of the theory.

What looks like a very important application of colloid chemistry is the breaking of metals under fatigue tests. There is considerable evidence to show that non-metallic inclusions, or sonims, are an important factor in determining the life of a bar under fatigue tests; if this is true and if it proves possible to eliminate sonims economically, this means a complete revolution in engineering practice. The possibilities are wonderful, first to aviation and then to the world at large. I do not guarantee the calculation; but I have been told that if all metal were as good as the best that is now made, it would be possible to cut the weight of a locomotive to that of a Ford car without decreasing its power, though the loss of traction would be large.

### Relation of Colloid Chemistry to Corrosion

Another problem which is essentially colloid chemistry is corrosion. Practically all metals corrode in contact with aqueous solutions and air. While there are all gradations of corrosion and while it is possible that we cannot draw a sharp dividing line, we can distinguish the extreme cases without difficulty. In the one case, the corrosion continues until the metal is destroyed, and in the other the attack comes practically to a standstill. Iron and nickel are two striking illustrations of this. Although iron and nickel are close together in the periodic table, we electroplate iron with nickel in order to preserve it.

If a metallic surface is corroded by the medium, the attack might continue as long as the unchanged surface is exposed to the unchanged medium. A cessation of the attack under otherwise unchanged conditions can occur only when the unchanged medium does not come in contact with the unchanged metallic surface; in other words, when the metallic surface becomes coated with a film that prevents the corroding medium from coming in contact with the metallic surface. In a way this is a truism. Everybody knows it except the people who study corrosion. We paint or varnish metals to protect

* First Annual Lecture of Institute of Metals Division, New York Meeting, February, 1923.

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them. We know that aluminum and nickel owe their relative stability to the formation of an oxide film. Everybody knows that a copper roof turns green fairly rapidly and that the coating of basic carbonate retards the action of the weather on the underlying copper. Parkerized iron owes its resistance to corrosion to the presence of a film of oil and phosphate. Coating iron suitably with ferro-ferric oxide decreases the corrosion, while an unsuitable coating with the same compound accelerates the corrosion. Lead and lead peroxide in sulfuric acid form a storage battery; but the positive plate consists of lead and lead peroxide without being a short-circuited cell, because the lead peroxide coats the lead and prevents the sulfuric acid from coming in contact with it. The whole problem of retarded corrosion is, therefore, essentially a question of film formation. This has been recognized explicitly by Buck, Richardson, and others; but it is not generally accepted as yet and little has been done along the line of determining the theoretical conditions necessary for the formation of a protecting film.

Ore flotation is an important process technically and one of great interest to the colloid chemist. In the process, as worked under the patents of the Minerals Separation Co., a relatively small amount of oil is added to the pulp and air is beaten into it. If there were only oil and water present, we should get bubbles of air with an oil film between the air and the water and these would be so fragile that they would break at once on reaching the surface. As the sulfide ore is wetted more readily by the oil than the siliceous gangue, it passes into the oil film, making the latter very viscous and producing a stable froth that rises to the surface, carrying much of the valuable minerals with it, while the siliceous gangue settles to the bottom of the tank. If the amount of air bubbles is very large relatively to the ore, as in the Callow process, the bubbles are not so heavily coated with sulfide and consequently are much more fragile. The one process aims to give a stable froth and the other a fragile froth. To this extent at least the two processes are fundamentally different. The separation of the sulfide particles from the gangue is said to take place at the top of the tank in the Callow process and in the mass of the liquid in the Minerals Separation Co.'s process; but a discussion of this would carry us too far afield.

## Soluble Silica in the Preparation of Zinc-sulfate Solution for Electrolysis*

By J. O. Betterton, Omaha, Neb.

RECENTLY some experimental work was conducted by the author in connection with the direct leaching of certain zinc ores with sulfuric acid with the object of subsequently recovering the zinc by electrolysis. The ores contained relatively large quantities of soluble silica, making it necessary to evolve special methods for handling the silicate solutions resulting from a leach of the ore, and also for the final removal of the silica before electrolysis. The problem was complicated by the presence of vanadium in the ore, the commercial recovery of which was very desirable. This paper, however, deals only with the silica phase of the problem.

The zinc in the ore occurs in the form of a silicate (Hemimorphite) and, to a very small extent, as the phosphate (Hopeite) and carbonate (Calamine); the vanadium is found as Vanadinite but mainly as Descloizite.

The experimental work was done in a plant producing 50 lb. of zinc daily, in which the complete cycle of operations, including the final electro deposition of the zinc, was performed continuously for one year. Some of the conclusions given here are the result of the operations in this plant; the others are from laboratory tests inaugurated both as a guide to the plant operations and, in certain cases especially, to determine the limits in question.

In the early stages of the work, considerable trouble was experienced in the ore leach; this was later found to be caused by the more or less gelled condition of the slightly acid silicate solution. This part of the process was a decantation practice and sometimes the iron slimes in the ore residue would settle perfectly and at others they would settle hardly at all, with various degrees of settling between these extremes. Occasionally, a solution would visibly gel before it had sufficient time to be decanted off the ore residue, which was usually 18 hr. from the time of starting a leach. The factors thought to cause gelling that were investigated were:

1. *Temperature.*—Below 45° C., the maximum temperature resulting from the action of the acid on the ore during a leach, there was no effect; temperatures as high as 90° C. resulted in no action, within several hours, at least.

2. *Carbon Dioxide.*—Both high-grade zinc-carbonate ore, containing some soluble silica, and mixtures composed half and half of carbonate and silicate of zinc were tried and no gelling tendencies were noted.

3. *Air.*—In order to determine whether the Pachuca tank could be used for the leach, a small test apparatus was rigged up. Several leaches were duplicated in respect to all conditions on the small scale and compared to simultaneous leaches with the mechanical agitator ordinarily used. No difference could be detected in the behavior of the resulting solutions, hence the conclusion that the use of compressed air under ordinary operating conditions is without effect.

4. *Oxidizing Compounds in the Spent Electrolyte (Permanganates, Manganates and Chlorates).*—No differences due to this cause could be detected. In making the comparisons, samples of ore were leached directly with spent electrolyte, and again with the

* New York Meeting, February, 1923.[1]

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same spent electrolyte after its oxidizing power had been balanced with ferrous sulfate.

5. *Zinc Concentration or the Effect of a Strong Electrolyte.*—The effect of this was most marked. By keeping the acidity and silica constant in a series of tests and varying the zinc, it can definitely be demonstrated that an extremely regular relation between the zinc concentration and time of gelling exists—the higher the zinc, the sooner the gelling. An inspection of curves plotted show that, given the acidity, zinc, and silica contents of a solution, its time of incipient gelling can be quite accurately predicted.

6. *Acidity.*—By exactly similar methods, it was shown that the higher the free acid, the quicker the gelling.

7. *Silica Concentration.*—Following the same procedure of varying but one of the three variables at a time, it was shown that the time interval preceding incipient gelling is shortened as the silica is increased from 8.00 to 10.00 gm. silica per liter. The curve then reverses and the time interval rapidly increases as the silica increases from 10.00 to 13.00 gm. per liter. This is an important consideration in connection with practical operations and has been confirmed in a large measure by subsequent operations of the 50-lb. plant. Here solutions containing as high as 100 gm. zinc, 5 gm. free acid, and 20 gm. silica per liter have been successfully handled.

A method for removing the silica from solution in filterable and washable form, or the so-called granular condition, was developed much in advance of a complete understanding of the factors governing gelling in the acid solutions.

### Conclusions

In these conclusions, all statements are to be accepted in the sense of their application to practical zinc metallurgy.

1. The conditions governing the gelling of acid silicate solutions are simple, and essentially consist of three variables, zinc, silica, and acid concentrations of the solutions.

2. The time of gelling can be predicted, conditions as to acid, zinc, and silica concentrations being known.

3. The limits for safe work are ample, both as regards concentration of zinc in solution and time necessary for operations ordinarily to be employed.

4. The silica can be readily removed in a filterable, washable form, without excessive acid losses or the introduction of elements other than zinc.

## Action of Mud-laden Fluids in Wells*

By Arthur Knapp, Philadelphia, Pa.

THERE seems to have been little investigation of what actually happens when mud-laden fluids are applied to a loose porous sand. The assumption is that the fluids penetrate the sands and that there is some plastering action. The degree of penetration and the relation of plastering action to wall stability is not generally known. This paper describes a series of experiments made in an attempt to observe, in laboratory apparatus, the action of mud-laden fluids under conditions simulating those to be found in a well. For the purposes of this discussion all fluids containing solid matter in suspension are mud-laden fluids.

Mud-laden fluids made up with brickyard clay, cement, oxide of iron, acid and alkaline muds, hydrated lime, infusorial earth, kaolin, and several other ingredients were experimented with.

The results of these experiments lead to the following conclusions:

1. The penetration of the mud-laden fluids into the pores of the wall of a well is very slight, not over 1 or 2 inches.

2. The stability of the wall of a well depends on:

(*a*) The cohesion imparted to the sand grains by the mud-laden fluid; (*b*) The formation upon the surface of the hole of a plastic solid deposit of material from the mud-laden fluid by filtration; (*c*) The plastering action where filtering is not possible; (*d*) The static head of the fluid column.

3. The resistance offered by the wall-forming material to erosion has a great deal to do with its utility as a circulating medium.

4. In bringing in a well in which the productive horizon has been mudded off, it is necessary to destroy mechanically the well wall to the depth of several inches, as the mud-laden fluid cannot be forced out of the pores and the filter-packed material forms a continuous arch that is strong enough to resist considerable pressure and does not erode or wash away readily.

5. The fact that the mud-laden fluid will settle rapidly does not condemn it as a circulating fluid, provided its other wall properties are good. It may condemn the fluid for drilling purposes if the settling is so rapid as to tend to stick to the tools or casing.

6. It might greatly facilitate the bringing in of a well if a few barrels of light oil were pumped into a well as a final flush just before the screen is unhooked and also if a few barrels were pumped on the inside of the screen as a wash pipe is pulled. The oil appears to have an active cutting action on the clay mud so that heavy mud could be more easily washed out if cut by oil.

7. While there is evidence that wells have been drilled through productive horizons and the oil shut off completely by the mud-laden fluid used in drilling, it is probable that some of these wells would have been commercial producers if washed and bailed for a sufficient length of time or if they had been bailed down and allowed to stand for a sufficient length of time to allow the oil to work its way through the mud.

* New York meeting, February, 1923.

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8. Uncemented oil sands should be drilled into with a thick well-mixed mud.

9. The failure of an oil horizon to produce oil may sometimes be explained by the fact that water or thin mud will form a tenaceous coating or emulsion on the oil sand.

10. The washing of a well with heavy, well-mixed clay mud will tend to destroy any emulsion that has formed on the oil sand and obstructs the flow of oil to the well and may assist in bringing in the well. Clear water will remove the mud, while it will have no effect upon the emulsion.

11. When the walls of a well have caved badly, for any reason, it would be much better to allow the well to stand for a few hours than to try to re-drill the hole and stop the cave immediately.

12. The hole drilled in uncemented oil sands is greater in diameter than the average diameter of the rest of the hole.

13. Even a small quantity of cement added to clay mud increases the stability of the wall considerably and has no detrimental effects.

14. The resistance of well-established walls to the erosion by water leads to the belief that muds may be safely thinned much more than is usually considered practical when drilling clay, gumbo, or gypsum.

15. In general, the finer the solid particles in suspension in a mud-laden fluid the better are its wall-building properties.

16. If materials other than clay are available, such as oxide of iron or kaolin, they may be used to great advantage in "lubricating" wells making oil, as they are not affected by the oil to the same extent as clay.

17. It is possible for water to form channels through loose uncemented sands through which the water will reach the well from long distances thus bypassing large quantities of oil.

18. The total deposit on the wall of a well is independent of the thickness of the circulating fluid, within the limits of the muds ordinarily used for drilling or mudding off.

19. The thickness of the wall deposit is independent of the depth.

20. The thickness of the deposit is different for different mud-laden fluids.

21. Although the wall of a well may be so sealed with filter-packed material as to prevent further infiltration of water, it may not be sealed against the filtration of oil under the same pressure.

22. Steam mixing improves the quality of clay muds. Steam mixing may be employed to advantage where the raw product is poor; also, where it is desirable to increase the quality of the mud as when large bodies of loose sands are expected or in mudding-off processes when the pressure of gas or underground waters is excessive.

## Use of Magnetic Ore in the Blast Furnace*

By G. P. Pilling, Philadelphia, Pa.

THIS paper compares notes on the use of magnetic ore in the blast furnace with some comment as to design and difficulties encountered, with particular reference to the ores of Eastern Pennsylvania and the Adirondack Region.

The use of magnetic ore in the blast furnace is a subject of increasing importance. The end of the deposits of lake ore is in sight, although not imminent, and unless some new field is discovered, the use of magnetites will be an increasing factor in the iron production of the country. Enormous deposits of magnetic ore in the country that have been practically untouched contain ore of sufficient richness and purity to materially prolong our ore supply without extensive importation of foreign ores.

Magnetic ores can be divided into three general classes: Fine unsintered, or raw ore; raw lumpy ore; fine ore that has been sintered. The successful use of fine magnetic ore in the blast furnace depends on a number of factors, all of which must be carefully determined for each individual case. However, there are a number of basic principles which are briefly discussed here.

### Correct Furnace Design

The first thing to consider when designing a furnace is that the reduction of this ore requires from 3 to 4 hr. longer than an equal amount of hematite. The working volume above the tuyeres must therefore be larger. The next thing to be considered is the design of the bosh. Unless every precaution is taken, the fine magnetic ores tend to work in a high zone of fusion in the furnace, thereby raising the ratio of direct to indirect reduction, which, of course, tends to high fuel and poor furnace results. The next point for consideration is the batter of the inwall. This is governed by three considerations.

One of the greatest difficulties met with in working fine magnetic ores is the correct stock distribution. It is necessary to procure almost theoretically perfect distribution of the ore from the bell on to the stock, for after the ore has been placed on the top of the charge, it has practically no lateral movement, *i.e.*, the ore will not work from the outside of the furnace toward the center or vice versa. This means that the size of the coke unit, which necessarily governs the size of the ore unit, must be carefully studied and regulated; it is considerably larger than the coke unit used with hematite ores. It is common practice when using fine magnetic ores to use a 45° angle bell and not over 2 ft. clearance between the bell and the stock line.

On account of the hard, dense nature of fine magnetic

* New York Meeting, February, 1923.

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ore, it is necessary to allow not less than 11 hr. and preferably 12 to 14 hr. for reduction. If the furnace is driven faster than this, in from 48 to 60 hr., it will start to work cold and unreduced ore will appear in front of the tuyeres, the slag will become black with small particles of ore floating on the top, the silicon in the iron will be lowered, and the sulfur in the iron will rise very rapidly.

When working these fine magnetic ores, care must be taken not to have the tuyere area too large. It is not practicable to blow as much air when smelting fine magnetic ores as when smelting an equivalent hematite ore.

Most furnaces using these magnetic ores use a calcite stone when it is available, although very good work is being done with a low magnesia dolomite. All the stone used for flux should be crushed to not larger than 4 in. and all fines under ¾ in. screened out.

It is very important that the coke used shall burn freely and quickly at the tuyeres, at the same time it should be dense enough so that there will not be an excess of loss by solution and direct reduction by carbon.

The fuel consumption, when using 100 per cent. of this grade of ore, is uniformly higher than that of hematite or sintered magnetic ore. The iron produced is usually quite low in sulfur. If it is necessary to produce a large tonnage of high-silicon iron, the best results are obtained by using a small percentage of siliceous hematite ore in the mixture, as it is extremely difficult to produce high-silicon iron using 100 per cent. of fine magnetic ore.

On account of the absence of sulfur in these ores, it is possible to run uniformly high acids in the slag. Furnace operation is practically entirely free from the troubles resulting from hanging and slipping, such as are encountered when working hematities.

Typical results of small furnace using 100 per cent. fine magnetic concentrates are given in this paper.

### Raw Lumpy Magnetic Ore

The writer is not familiar with any furnaces operating on 100 per cent. raw lumpy magnetic and trusts that this practice will be brought out in the discussion of this paper. Inasmuch as these lumpy magnetic ores are used with a large percentage of hematite ores, the furnace design is naturally a compromise.

The problem of stock distribution, when using lumpy magnetic ores mixed with hematite ores, is not so difficult as with 100 per cent. fine magnetic concentrates, for these lumpy magnetic ores do not show the same tendency to run ahead in the furnace, particularly when used with a large percentage of finer hematites. On account of their hard dense nature, these lumpy magnetic require as long a time for reduction in the furnace as the fine magnetic concentrates, or longer; from 12 to 14 hr. are required for thorough reduction. The same practice holds good for air distribution and tuyere area on the lumpy magnetic ores as on the fine magnetic ores.

Furnace operation when using a large percentage of lumpy magnetic ores is practically entirely free from the troubles resulting from hanging and slipping, such as are encountered when working 100 per cent. hematites.

### Fine Magnetic Ore Which Has Been Sintered

There is no furnace, so far as is known at the present time, operating on 100 per cent. sintered magnetic ore. The closest approach to it is a small furnace working an ore burden of 80 to 85 per cent. sintered fine magnetic ore, 10 to 15 per cent. mixed puddle and heating cinder, and 5 per cent. hematite ore.

The magnetic ore under discussion (eastern Pennsylvania), as mined, contains about 53 per cent. of iron and 3 per cent. of sulfur. The sinter contains about 0.18 per cent. sulfur and physically is in ideal shape for blast-furnace use. The bosh angle of the furnace discussed is rather flatter than for most modern furnaces, as this is an old furnace remodeled.

The problem of stock distribution with sintered magnetic concentrates does not seem to be as difficult as when lumpy or fine unsintered magnetic ore is used. One of the greatest advantages of using sintered magnetic ore is that the rate of driving can be materially increased.

As for the raw magnetic ores, about 150 cu. ft. per minute engine displacement of air per square inch of tuyere area give the best results. The flue-dust losses, on sintered ore, are very low so that it is possible to blow more air than with fine magnetic concentrates. This increased volume of air does not make the furnace drive too fast for proper reduction, inasmuch as the time required for reduction is much less.

Sintered magnetic ore can be successfully mixed in any proportion with hematite ores and good results obtained. Because of the fairly high sulfur content of the sintered ore, which comprises 85 per cent. of the mixture, it is necessary to carry a large slag volume.

A furnace operating on a large percentage of sintered magnetic concentrates seems to be freer from furnace troubles and irregularities than any other kind of ore.

From the results obtained on this furnace using this large percentage of sintered magnetic ore, it has been demonstrated that the fuel consumption is from 150 to 300 lb. lower and the product about 30 tons per day higher than could be expected from an equivalent size furnace using the same proportion of either raw fine magnetic concentrates or raw lumpy magnetic ore. The operation of the furnace is greatly simplified and the results obtained are most satisfactory from every standpoint.

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# Personal Notes and Biographies

**Philip Kriegel** is metallurgist with Thomas A. Edison at Orange, N. J.

**F. Dean Bradley** is principal of the Tonopah Mining and Industrial School, Tonopah, Nev.

**Frank B. Davenport** is at Merrimac Mines, Va., as assistant general manager of the Merrimac Anthracite Coal Corporation.

**C. A. Burdick** is valuation engineer with the Federal Income Tax Unit of the Treasury Department, Washington, D. C., on general mining.

**Léon Feuchère** has severed his connection with the Copper Queen Consolidated Copper Co., but will remain in Bisbee, Ariz., to undertake leasing on his own account.

**Samuel L. Hoyt,** formerly metallurgical engineer in the experimental engineering laboratory at Nela Park, Cleveland, Ohio, is at the Research Laboratory, General Electric Co., Schenectady, N. Y.

**Frederick B. Kollberg,** recently in Nacozari, Mexico, has gone to Ajo, Ariz., to assume charge of the construction of the new 5000-ton concentrating mill to be built by the New Cornelia Copper Co.

**Frank K. Weaver,** formerly with the Kanawha Black Bond Coal Co. of Olcott, W. Va., is a member of the firm of Weaver, Wilson & Burtnett, Civil, Mining & Consulting Engineers, 6 Morrison Bldg., Charleston, West Va.

**George Otis Smith,** director of the U. S. Geological Survey, resigned that position to become a legally qualified member of the coal commission appointed by the President. His successor is **Philip S. Smith,** who has been administrative geologist for the Survey.

**David White,** who has been chief geologist of the U. S. Geological Survey for ten years, has resigned in order to resume his research work. The new chief geologist will be **W. C. Mendenhall,** recently geologist in charge of the Land Classification Board of the Survey.

**Charles R. Fettke,** associate professor of geology and mineralogy at the Carnegie Institute of Technology, Pittsburgh, Pa., has completed an investigation of the oil resources of the coals and carbonaceous shales of Pennsylvania for the State Bureau of Topographic and Geological Survey.

**H. O. Williams,** as director of preparedness on the Disaster Relief Committee of the Red Cross in Cambria County, Pa., had charge of all relief work after the Spangler disaster. The Cambria Red Cross unit started for Spangler about an hour after the explosion occurred.

**G. H. Cunningham,** chief engineer for the Electrolytic Zinc Co. of Australasia, has been visiting the Continent, Scandinavia and England for some months on behalf of his company. Mr. Cunningham has also spent several months in the United States. He returned to Australia early in November.

## Hjalmar Sjögren

THE cables brought the news last spring that the Institute had lost by death one of its most distinguished foreign members, Hjalmar Sjögren of Stockholm. For thirty-one years, Professor Sjögren had been one of our number. He was elected in 1891, joining the Institute at the time he was in the United States, in attendance at the Fifth International Geological Congress, which was held in Washington in the late summer of that year. Professor Sjögren was once more in America in 1906 and again in 1913, and on both of those visits his friends in New York had the welcome opportunity of extending courtesies to him. He was thus well known to a wide circle in our membership.

His keen interest in the geology of iron ores brought him in touch with the many Americans who have studied them and who have been active in the important productive districts which he visited. Our TRANSACTIONS contain (Vol. 38) one very important paper of seventy pages on the Geological Relations of the Scandinavian Iron Ores, which he contributed.

Sten Anders Hjalmar Sjögren, to give his full baptismal name, was born June 13, 1856, and was the son of Anton Sjögren, a mining engineer, at the time in charge of the iron mines at Persberg, in the east and west iron ore belt of central Sweden, about 160 miles west from Stockholm. The Persberg orebodies yielded magnetite and specular hematite from schists, with which limestones were interstratified as well as the peculiar Swedish rocks called "hälleflinte." The mines were also well known to collectors and students of minerals.

While Hjalmar Sjögren was yet a lad, his father was advanced to the superintendency of a number of famous mining localities in this same district of Werm-

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land. Paisberg, famous for its native lead, was one; and two others, Långban and Nordmarken, were among the most prolific sources of interesting minerals in all Sweden. In several localities, the pre-Cambrian limestones had obviously experienced the recrystallizing influences of intrusive igneous rocks and had been charged with the so-called "contact" minerals, which have found their way to the museums of the world. Anton Sjögren, the father, was a keen mineralogist and Hjalmar, the son, grew up in a favorable environment for receiving training and enthusiasms of the same sort. One is not surprised, therefore, to find Hjalmar Sjögren, in the long run, turning to mineralogy and geology as his final career.

In 1875, at the age of nineteen, young Sjögren matriculated at the Polytechnical School in Stockholm, where he spent three years. In 1878, he entered the University of Lund and after two years passed his examinations for the mining engineer's profession. During his student period he also had field experience in geological work and began the publication of his long series of papers on minerals, some old, some new and first named by him. On graduating, the young mining engineer entered the active work of the profession and continued it for two years; then for two years he gave the instruction in mineralogy at the famous old Swedish university of Upsala, where the traditions of Linnaeus and Berzelius still live as an inspiration to teachers and taught. Inevitably, Instructor Sjögren continued with increasing productivity his publications, both in mineralogy and geology, and what is of especial moment in connection with this tribute, he began his important series on iron ores.

### Bulletin of Upsala University

In 1885, Hjalmar Sjögren became geologist for the Nobel oil wells, and refineries at Baku on the Caspian Sea, and for four years studied the geology of the oil fields and of the regions round about, acquiring thus data for a series of scientific papers. Returning to Sweden, he became, in 1890, professor of geology and mineralogy at Upsala, and was married to Anna Nobel, the daughter of Ludwig Nobel. At once the laboratories of the university were equipped with the best of apparatus and placed in a position to carry on researches with the necessary facilities. The well-known "Bulletin of the Geological Institute of the University of Upsala" was established and furnished a medium of publication. The first volume was completed in 1893, and has been followed by seventeen others, the entire expense of the series having been borne by Professor Sjögren. The series is one of the most valuable of all the publications in geology and mineralogy. The volumes are beautifully issued and are in all the large scientific libraries of the world.

In 1894, after four years of service, Professor Sjögren retired from the chair at Upsala and occupied himself primarily with the great business interests and other similar affairs with which he had necessarily become associated. In 1901, however, he took charge of the collections of minerals in the Royal Museum at Stockholm and reorganized the exhibits, both in materials and display, until they were able to supply to the delegates at the Eleventh International Geological Congress of 1910 one of the most striking and instructive features of Stockholm. To the mineralogical treasures of the state, Professor Sjögren added his own collection which was of outstanding scientific and historical value. The great contribution of the above Congress was the two-volume work on the Iron Ore Reserves of the World. In its preparation Professor Sjögren took a leading part; and at the distinguished symposium upon the question "What shall the iron industry do for ore in the future?" he followed the address of the Swedish Prime Minister, with a summary of the world-wide inquiry. During the Congress, and as one of its most enjoyable features, Professor and Mrs. Sjögren made their guests, for an afternoon and evening at their beautiful estate of Nynäs, an hour's ride from Stockholm, one hundred and fifty of the delegates and their wives. A sumptuous banquet was spread after which a vast display of fireworks illuminated the grounds. As one of those present, the writer can bear witness to the great pleasure given to visitors from all parts of the world.

Since the year of the Congress in Stockholm, Professor Sjögren has been busied with scientific labors and administrative duties of many kinds and with journeys of world-wide extent. At the time of his death an important work entitled "A Handbook of Swedish Mineralogy" was in large part in manuscript, and a translation from the Latin into Swedish of Swedenborg's treatise on iron, in his "Opera philosophica et mineralia," was so far advanced that it can be carried to publication.

Aside from Professor Sjögren's many contributions to mineralogy, his numerous papers on the geology of iron ores possess the greatest interest for members of the Institute. His writings on the latter subject show remarkably well the gradual evolution through which our trusted views have passed, alike in Scandinavia and America. At first, even for the ancient magnetites and specular ores sedimentary explanations were exclusively set forth; but gradually the need of aid from igneous influences and contributions becomes more and more apparent and their importance is more fully recognized in his latest contributions. A full bibliography of Professor Sjögren's writings accompanies a beautifully written and appreciative sketch of his life by Professor A. G. Högbom, his successor in the chair at the University of Upsala. The memorial is published in Volume XVIII of the Bulletin of the Geological Institute of the University. The writer's personal recollections have been greatly aided by this memorial in preparing the present tribute.

James F. Kemp.

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## R. C. Gemmell

ROBERT CAMPBELL GEMMELL, assistant managing director of the Jackling allied porphyry mining properties in Utah, New Mexico, Arizona and Nevada, died suddenly on Oct. 25, of heart trouble, while traveling from Hurley, N. M., to Los Angeles.

To justly shape even an outline of the brilliant career and uniquely charming personality of Mr. Gemmell is well-nigh impossible, and any effort so to do can but demonstrate the inadequacy of language to sound the depths of soul-stirring sentiments. To touch upon his more important work, and afford even a limited conception of his general worth and character, is all I can hope to do.

Robert Campbell Gemmell, the son of Robert Brown Gemmell and Anna Eliza Campbell Gemmell, was born at Port Mathilda, Pa., on July 5, 1863. In the early 70's, his parents moved to Topeka, Kansas, in which city Mr. Gemmell secured a common school education and graduated from the Topeka High School. His father being in, and having made good at, the railroad business, Mr. Gemmell decided upon becoming a civil engineer, and to that end, in 1880, entered upon the study of his profession at the University of Michigan, from which he received his degree of B. S. in 1884.

From the summer of 1884 until the summer of 1890, he was employed in the engineering department of the Atchison, Topeka & Santa Fe Railway Co., rising to the position of division engineer in charge of construction work, with 2000 men under his direction. In 1891, he located in Pendleton, Ore., where he engaged in an extensive private practice of his profession extending over Oregon, Washington and Idaho. In 1893, he located in Salt Lake City, Utah, where, in addition to his private practice, he was employed in the engineering department of the city. He returned to his alma mater, at Ann Harbor, Michigan, and there received his degree of C. E., in 1895. Resuming his practice in Salt Lake City, he became engineer for the mines of Capt. Joseph R. DeLamar including the Golden Gate and the Consolidated Mercur properties at Mercur, Utah. Upon the admission of Utah to statehood in the Union, he became its first state engineer, and held that position from 1898 to 1901. He next went to Mexico as manager of the Mexican Syndicate Mining Co., followed by the superintendency of the properties of the Guggenheim Exploration Co. In Mexico, he acquired proficiency in the Spanish language. In 1905, he journeyed to Spain, where he examined gold-mining properties for a syndicate of New York capitalists.

Immediately upon his return, and in January, 1906, he became associated, in the capacity of superintendent of mine and mills, with the Utah Copper Co., of which D. C. Jackling was then general manager, and continued with that company, which through the joint efforts of those gentlemen has been brought to such a productiveness as to make its name known throughout the mining and financial world. Three years later he became assistant general manager of the Utah Copper Co. and on May 1, 1913, became its general manager, succeeding Mr. Jackling, whose various and extended interests obliged him to move to San Francisco, Cal., and who became its managing director and vice-president. At this time, in June, 1913, his university conferred upon Mr. Gemmell the honorary degree of Master of Engineers, the highest degree the profession affords. During these years, he became consulting

ROBERT C. GEMMELL

engineer for the Ray Consolidated Copper Co., the Chino Copper Co., and the Nevada Consolidated Copper Co., as well as general manager of the Bingham & Garfield Railway Co. In June, 1919, he was made assistant managing director of the Utah, Ray, Chino, and Nevada properties, in which capacity he had visited the Chino property, when, on Oct. 25 last, while en route to Los Angeles, Cal., on the Sunset Limited, he lay down to take a nap, and, while he was sleeping peacefully, passed away.

On Oct. 17, 1888, Mr. Gemmell married Miss Belle Evans Anderson, of Salt Lake City, who was also a Michigan graduate, and a leader in the social and club life of this city, and who survives him.

He was fond of hunting and fishing, an ardent golf player, and a clubman of popularity and prominence. He was never too busy to concern himself with the uplift of boys, and it pleased him, beyond measure, to contribute to their happiness. The public good found him always responsive to the demands and duties of patriotic citizenship. All that tended to aid Utah in a

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material way, to develop her resources, add to her capital, population or industries, to encourage education, and to relieve the suffering of her needy, found in him a ready and enthusiastic champion.

He was a true man in all that the word implies. His genuine individuality never resorted to an artificial diplomacy, never pretended to an agreement for the sake of an advantage, and never made concessions to escape responsibilities. His broad and liberal views, his moral and upright character, his kind and gentle disposition, his polite and unassuming manner, his frank, generous, hearty, cheery good will to all, won men to him and gave him a power over human hearts which was both deep and strong. His career was one of magnificent development and broad usefulness. Seldom have men been endowed with such vigor of intellect. His was a sober judgment that measured opportunities, and the sagacity and self poise that enabled him to plan wisely and execute efficiently. The lofty heights reached by him in his chosen profession bear indisputable testimony of his untiring zeal, unconquerable energy and unquestionable ability.

The engineering profession can have no better thing to be proud of than such a character; in all her store, she has no richer jewel to display than the fame of such a son. Mr. Gemmell well earned the high position he held in our councils and in our hearts.

A whiter soul, a fairer mind,
A life with purer course and aim,
A gentler eye, a voice more kind,
We may not look on earth to find;
The love that lingers o'er his name,
Is more than fame.

Mr. Gemmell was a member of the American Institute of Mining and Metallurgical Engineers, the Mining and Metallurgical Society of America, the American Society of Civil Engineers, the Utah Chapter of the American Mining Congress (he was the prime organizer and the first governor of this chapter), and the Sons of the American Revolution. He was honorary president and national representative of the Salt Lake Council of the Boy Scouts of America. He was also appointed by the Governor of Utah on the committee which, in 1916, prepared the draft of the Workmen's Compensation Act of Utah.

He was a member of the Alta, the University, the Country, the Commercial and Rotary Clubs of Salt Lake City; of the Rudy Duck and the Bear River Duck Clubs of Utah; of the Flat Rock Club of Idaho; and of the Sequoyah Country Club of Oakland, Cal.

D. C. Jackling, in a letter written to the Institute, expressed the feeling of Mr. Gemmell's many friends. He said: "Gemmell, personally, was the kind of man whom it was a rare privilege to know and call friend; as an engineer, he was capable and thorough to the degree of brilliance; as an operating official, he was patient and considerate as few men have the character to be, but, at the same time, persistent to a degree that could not be satisfied by anything short of economic perfection. Altogether, he was a great man, a great engineer, and a great friend."

L. S. Cates.

## Walter C. Witherbee

WALTER CRAFTS WITHERBEE died at his residence, "Ledgetop," Port Henry, N. Y., on Sept. 28. Mr. Witherbee was born in Port Henry in 1856. His father, Silas H. Witherbee, was one of the founders of the firm of Witherbee, Sherman & Co. and Mr. Witherbee succeeded his father as a member of the firm. He graduated from Yale college in the class of 1880.

Early in life he became interested in politics and was for many years a leading figure in the councils of the Republican Party, not only locally, but in the state and nation. He rarely held elective office, finding his greatest usefulness in an advisory rather than an executive capacity. He was collector of the Port of Plattsburg, having been appointed by two Presidents and was treasurer of the Champlain Tercentenary Commission. For his services in this connection he was decorated with the Cross of the Legion of Honor by the French Government.

In March of this year he was chosen by Governor Miller as a delegate from New York State to the National Rivers and Harbors Congress and the National Merchant Marine Association which convened at Washington at that time, but illness prevented him from fulfilling this duty.

Mr. Witherbee was prominent in all activities that made for the advancement of his home town. Besides Witherbee, Sherman & Co., which was his principal interest and in the development of which he played a large part, he was president of the Citizens National Bank, of Port Henry, president of the Port Henry Chamber of Commerce, president of the Port Henry Country Club, president of the Port Henry Steam Ferry Co., president of the Lake Champlain Fish and Game Club, director of the Mountain Home Telephone Co., honorary chairman of the newly organized Essex County Young Men's Christian Association, director of the New York Forest, Fish and Game League, for many years an officer and director of the Port Henry Iron Ore Co., and the Lake Champlain and Moriah railroad company, a trustee of the First Presbyterian church, a member of the Lake Champlain Commandery, Knight Templars, Cedar Point Chapter, R. A. M. and Morning Sun Lodge, F. and A. M., Plattsburg Lodge 621, B. P. O. E. He belonged also to many societies and clubs.

His charity knew neither race nor creed and his purse was always open to poor and unfortunate. His generosity was unlimited. From the time of the announcement of his death until after the funeral service flags throughout the village were flown at half mast as a

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respect to his memory. The bereaved family received telegrams of sympathy from all over the country and from persons high in affairs of the state and nation.

Mr. Witherbee married, in 1886, Miss Annie E. Gautier of New York City, who survives him. Of their four children the eldest son died in 1905 and there survive Silas H. Witherbee, of Greenwich, Conn., Mrs. A. Stanton Merrill, American Embassy, Constantinople, and Miss Annie C. Witherbee of Port Henry. Mrs. Robert C. Black, of New York City, a sister, also survives him.

## William J. Keep

WILLIAM J. KEEP, who became a member of the A. I. M. E. in 1888, died suddenly on Sept. 30, 1918, following a street-car accident, but notice of his death did not reach the Secretary's office until a few weeks ago.

Mr. Keep was born in Oberlin, Ohio, in 1842, and was of New England and New York Dutch ancestry. He received the C. E. degree from Union College. He settled in Troy, N. Y., where he gave a course of lectures on the steam engine at Rensselaer Polytechnic Institute and later was associated with the firm of Fuller, Warren & Co. In 1884, he moved to Detroit, where, for many years, he was consulting engineer with the Michigan Stove Company.

Mr. Keep spent a great deal of time in investigation of the properties of cast iron, and manufactured testing machines. He discovered a mechanical analysis for cast iron, called Keep's Test, which is still used largely in the United States and Canada, and he held many United States patents. He published a book on Cast Iron, in 1900, and wrote a number of papers for scientific societies.

Mr. Keep was a fellow of the American Association for the Advancement of Science; past vice-president of the American Society of Mechanical Engineers; past president, Detroit Engineering Society; member of the Iron and Steel Institute of Great Britain, International Association for Testing Materials, American Foundry Men's Association, Franklin Institute; honorary member of the Rensselaer Society of Engineers and the Philadelphia Foundrymen's Association.

Mr. Keeps' wife survives him; also a daughter, Helen E. Keep, of Detroit, and a son, Henry Keep, who lives at Elizabeth, N. J.

## Rukard Hurd

RUKARD HURD, director of the department of mines and natural resources of the Minnesota State Tax Commission, died at Frontenac, Minn., on July 27. He was the first secretary of the Commission, elected in April, 1907, and resigned that office in July, 1915, to accept the directorship.

Mr. Hurd was born in Cincinnati, Ohio, in 1858. He was graduated from the Pennsylvania Military College in 1878, as a civil engineer, and in 1912 received the honorary degree of doctor of philosophy from the same college.

In 1901, Mr. Hurd was representative in the Minnesota state legislature, and also served in the special tax session of 1902.

As secretary of the Tax Commission, Mr. Hurd was in charge of the iron-ore mineral development, and this work led to research which he described in scientific papers and which enabled him to write the "Iron Ore Manual," a general reference book on iron-ore costs and values of mineral leases.

Mr. Hurd was major and aid-de-camp on the military staff of the Governor of Minnesota in 1895–96 and 1899–1900. When the United States entered the World War, Mr. Hurd's intense patriotism led him to offer his services. He received his commission as Major of Engineers in the Reserve Corps in November, 1917, and served in Washington until his health broke down and his impaired eyesight compelled him to send in his resignation, in June, 1918.

Mr. Hurd was a member of the American Institute of Mining and Metallurgical Engineers and of the American Iron and Steel Institute; also of the Minnesota Society Sons of the Revolution and Society of Colonial Wars. He was a Scottish Rite Mason.

Samuel Lord, chairman of the Minnesota State Tax Commission, for many years associated with Mr. Hurd in personal and official capacities, is quoted as saying:

"Mr. Hurd was a gifted, resourceful and honorable man. He was ever loyal to his associates and friends, patriotic to the core, and generous to a fault. While naturally partial in his makeup and positive in his conclusions, he endeavored always to be just, and was uniformly kind. As secretary of the Tax Commission and later as director of mines, he performed a service that will be of lasting value to the state."

## Levi Holbrook

LEVI HOLBROOK was born in Westboro, Mass., March 7, 1836. He was a descendant of John Holbrook, who came from England in 1660 and settled in the Massachusetts Bay Colony.

Mr. Holbrook was prepared for college at Williston Seminary, Easthampton, Mass., and after one year spent in the West, he entered Yale. He was a member of Phi Beta Kappa and of Linonia.

During the six months following his graduation he was in Boston, under medical treatment for his eyes; then he took a horseback trip across the Rocky Mountains to the Columbia River and back, and resided in Danville, Va., for a time. From 1860 to 1863, as his eyes permitted, he was a student of modern languages and literature in Cambridge, Mass., part of the time being a resident graduate at Harvard University. Finally, however, he was obliged to abandon the idea of a literary life and from 1864 to 1867 he was

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engaged in financial business in Boston. The following year, he spent in New York, and then traveled for a year in Europe, Egypt and Asia Minor. In 1871, he returned to New York City.

Mr. Holbrook was a member of the New England Historic Genealogical Society, the Society of Colonial Wars, and the Sons of the Revolution, was registrar general of the Order of the Founders and Patriots of America from 1915 to 1920, and had been governor of the New York society of that order. He was also a member of the American Fine Arts Society, the Order of the Cincinnati, the American Geographical Society (of which he was a councillor and secretary), and the Geographical Society of America. He joined the American Institute of Mining Engineers in 1878, and served as manager from 1895 to 1897.

Mr. Holbrook died on July 26, 1922, from organic heart trouble, at his residence in Center Harbor, N. H. He was married, Dec. 27, 1871, in Newark, N. Y., to Viola, daughter of John A. and Elizabeth (Failing) Vowers, who died on Sept. 10, less than six weeks after her husband. His two children, Clark Holbrook of Red Bank, N. J., and Mrs. Julian P. Smith, survive him.

## Necrology

THE deaths of the following members were reported to the secretary's office during the month Oct. 16 to Nov. 15, 1922:

| Date of Election | Name | Date of Death |
|---|---|---|
| 1893 | Browne, Arthur B. | 1922 |
| 1907 | Corkill, Frederick | Feb. 1922 |
| 1903 | Gemmell, Robert C. | Oct. 25, 1922 |
| 1878 | Holbrook, Levi | July 26, 1922 |
| 1914 | Hurd, Rukard | July 27, 1922 |
| 1888 | Keep, W. J. | Sept. 30, 1918 |

# Correspondence and Discussion

## Smelter Troubles Twenty-five Years Ago

THE interesting contributions to MINING AND METALLURGY prompted by Colonel Dwight's article on "Evolution of Mechanical Roasting" remind me of the many difficulties under which we operated in those early days. I recently came across a letter which I had occasion to write to the president of the company owning the smelter that I was operating in Butte in 1897, which may be of interest in this connection in showing the dearth of information we had to guide us in undertaking costly constructions which in present day practice would not be considered for a minute. The following excerpts from this letter may be an interesting reminder of those old days to members of the older school.

In judging of the work done by the present reverberatory matting furnace, I would remind you that when it was first completed we had only one mechanical roaster, and one hand roasting furnace, and that for several months it smelted all the calcines and flue dust we could supply it with. It was only after the second mechanical roaster began operating, about March, that we had more calcines than the matte furnace would handle. Up to that time, therefore, the furnace was a success, because we smelted all the ore we could supply it with, using one-third less coal, and one-third less labor, than formerly used on the two old matting furnaces, which together did less work.

It is only since the latter part of March, when the second mechanical calciner commenced work, that the need of increasing the capacity of the matte furnace has been felt.

Hitherto the capacity of the furnace has varied from 50 tons to 66 tons per day. For a short time, and due to specially refractory ore, the capacity varied from 38 to 45 tons.

In designing the present furnace, I had little to guide me. I had Mr. . . . measure the two old furnaces and make drawings of them which I could study, I went down to talk with Mr. . . . but he would give me no information whatever. I talked with masons who had constructed this sort of furnaces, to get their ideas. My chief assistance came from Mr. . . . who not only interviewed different masons for me, but at my request went one night to Heinze's smelter, and measured a furnace which was in course of construction. The measurements he obtained there, I afterwards gave to Doctor Peters, and they are published in the seventh edition of his book, on page 470. I had Doctor Peters' former work on smelting, but his information is too general to be of very great value.

In comparing the work done by this furnace with the furnaces built by Richard Pearce and Henry Williams, remember that during the last 20 years they have built probably 40 or 50 furnaces, and their present furnace is the result not only of much experience, and many furnaces constructed and torn down, but they have had the advantage of consulting with each other, and what one might fail to see the other might notice. They have always devoted the greater part of their time to being around the smelters of which they have charge.

You say the furnace should smelt 75 tons daily, and because it does not you condemn it.

In Doctor Peters seventh edition of "Modern Copper Smelting," on pages 445 and 446, are given the various sizes of furnaces built by Mr. Pearce from 1878 to 1894, inclusive. The last furnace, he says, is 35 ft. long and 16 ft. wide, and smelts 50 tons of hot ore daily, with 13.5 tons of coal. Our present furnace is the same size as this, and has done fully as well.

A. H. WETHEY.

Paris, April, 1922.

## Water in Blister Copper Bars and Pigs

MAY I not point out that Dr. A. R. Ledoux is in error in his article under the above caption in the October issue of MINING AND METALLURGY, when he states that there has been no public discussion of this question? In the *Engineering & Mining Journal* for Dec. 3, 1910, p. 1095, he will find that I have there given a history of the discovery of the importance of moisture in copper bullion.

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I note also that Doctor Ledoux speaks of this water as being rain water. In making the original experiments detailed in the *Engineering & Mining Journal*, I came to the conclusion that the occluded moisture was probably not rain or bilge-water, but was the original bosh-water in which the copper bars were cooled. If Doctor Ledoux will read my original article, I should like to have him weigh the experimental evidence there presented in favor of this view.

DONALD M. LIDDELL.

Elizabeth, N. J., Oct. 20, 1922.

* * *

Doctor Ledoux's very interesting paper brings to my mind that during a period in one works we shipped to one refinery approximately 120,000,000 lb. of copper. During this period, the sum of the refinery weights differed by only one pound from the sum of the smelter shipping weights. During this same period we shipped about 60,000,000 lb. to another refinery and the weights from this refinery were always about 50 lb. less per car. The claim was made for water. So one carload was baked in a furnace before shipment and the usual shortage was reported by the refinery.

In another smelter, the copper was poured into molds. No water was used for cooling. The humidity in this place was exceedingly low. The refinery weights were low and they explained it by water in the bullion. In this case the silver assay on the refinery sample was nearly 5 per cent. low, although the smelter assayer checked the refinery assayer on the refinery sample.

Then complaint was made about the samples. The refinery claimed that there was slag attached to the bullion and to prove it furnished slag which was said to be attached to a certain shipment. When I had the slag assayed, the silver in the slag was higher than the silver in the bullion to which the slag was said to be attached.

E. H. HAMILTON.

Midvale, Utah, October, 1922.

* * *

I was glad to see Captain Liddell's and Mr. Hamilton's comments on my article on water in blister copper. One of the objects I had in view in writing the article was to promote discussion of a very important problem.

Captain Liddell's letter relates chiefly to how water gets into the interior of bars and pigs when they are bosh-cooled. The fact that this takes place was known long before water in blister copper was considered a serious problem, for occasionally when bars were bored, the drillings would come out wet even when there did not appear a cavity open to the surface, but it was not thought to be sufficiently frequent to affect the weight of the copper in any serious way. Therefore I dwelt more particularly on the fact that rain water can penetrate the porous surface of blister copper whether it has been cooled in the air or under water. There is no question that when these porous-topped bars are exposed to rain a certain amount of water is introduced.

I am not surprised at Mr. Hamilton's experience, for there are "refiners and refiners," as there are "smelters and smelters." With some of them our weights and assays conform closely, in others there are differences, and, as far as water is concerned, it does make a difference whether the material is heated for a brief time at 300° or for a longer time at 600° or over to determine moisture.

In regard to slag attached to the bullion, unfortunately that is not infrequent even today, and it is one of the sampler's most difficult problems to see that, when slag comes under the drill-point at the place where the template used indicates that a hole should be drilled, too much of this brittle slag does not get into the sample. I have frequently called the attention of shippers to this slag problem and in one case persuaded them to spray the bars with water while still hot, the result being that the slag decrepitated and could be brushed off when cold, leaving the surface comparatively clean. Not only are we sometimes troubled by the presence of slag but by the presence of clay used in patching up old molds. This clay, when at the bottom of the molds, sometimes flows up into the interior of the molten metal, so that drillings come out adulterated by its presence.

A. R. LEDOUX.

New York, Nov. 10, 1922.

## Coming Meetings of Societies

| Organization | Place | Date |
|---|---|---|
| Brazilian Centenary Exhibition | Rio de Janeiro, Brazil | To Mch. 31, 1923 |
| Amer. Pet. Inst. | St. Louis, Mo. | Dec. 6–8 |
| Amer. Soc. Mech. Engrs. | New York, N. Y. | Dec. 4–7 |
| Natl. Exposition Power & Mech. Engng. | New York, N. Y. | Dec. 7–13 |
| Coal Min. Inst. of Amer. | Pittsburgh, Pa. | Dec. 13–15 |
| Soc. Econ. Geologists | Ann Arbor, Mich. | Dec. 28–30 |

## Local Strikes

A NUMBER of local strikes have occurred since the big coal strike ended, employees of half a dozen operations quitting work to enforce payment of union fines or as a protest against disciplinary measures. For example, a fire boss in a mine of the western middle field neglected his work, and two men were burned in consequence. To discipline him for not looking after the men under his care, the company suspended him for two weeks. The colliery local ordered a strike, which went into effect on Nov. 11, to force the reinstatement of the man whose neglect resulted in serious injury of two workmen belonging to the local which struck.—*Boston News Bureau.*

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# Institute Affairs

## February Meeting of the Institute

THE annual meeting of the Institute will be held, as customary, in New York, on Feb. 19, 20 and 21, and it is expected that this meeting will draw together as large a group of members as attended the annual meeting last February. The details have not been fully arranged, but the program promises to be quite as interesting as last year.

The committees that are responsible for securing papers of interest have been extremely active during the past eight months and have succeeded in obtaining papers on a variety of subjects that will surely bring out some valuable discussion.

The Mining Methods Committee, led by its indefatigable chairman, will present a series of papers illustrative of the mining methods now in use in a number of the larger properties throughout the United States. The chief thought in this group of papers is economical production; the production of the largest tonnage per man consistent with clear and complete recovery of the deposit in question. Conditions surrounding each property vary so widely that there is no thought of a standard method, but an interchange of mining experience under varying conditions promises to be one of the most interesting features of the meeting.

The Petroleum Division will present several papers, and, as last year, is also preparing a symposium on the petroleum situation in the United States and abroad as of Jan. 1, 1923. The symposium of 1922 brought together a large group of petroleum specialists and an equally large group will be provided for this year.

The Drill Steel Committee will present the results of the research work it has been conducting during the past year. The work is not completed, but the progress report is most interesting, both from the view of the mine operator and the metallurgist who produces the steel.

The second annual lecture of the Institute of Metals Division will be given by Dr. Walter Rosenhain, of the National Physical Laboratory, England. Doctor Rosenhain will talk of Solid Solutions, a subject that is of decided interest to many outside of this particular division.

The Iron and Steel Committee has already procured several papers for its sessions, as have the committees dealing with the metallurgy of zinc and copper. The Precious Metals Committee and the Committee on Non-metallic Minerals have been equally successful in securing new and interesting material for discussion.

The Milling Methods Committee, which is conducting some important research work, will probably make a progress report, while the Coal and Coke Committee will present a series of papers covering the present condition of the byproduct coke industry very completely.

The Entertainment Committee does not make a confidant of the Secretary's office, but it is known that it has started on its program, and that the social features promise to be as attractive as in years past.

This very brief and sketchy outline of the February meeting is given merely as a hint of what members have to look forward to, just a hint to remind them that there are good reasons for planning now to attend the annual meeting.

## Dues for the Year 1923

IN ACCORDANCE with the provision of the Constitution, announcement is herewith made that dues of members will be payable Jan. 1, 1923. Two volumes of TRANSACTIONS, Vol. 68 and Vol. 69, will be issued during the year.

### MEMBERS

The dues of members cover payment for TRANSACTIONS and all other Institute regular publications.

| | | |
|---|---|---|
| Dues of Members | $15.00 | $15.00 |
| If TRANSACTIONS are bound, add | | 2.00 |
| Total | $15.00 or | $17.00 |

### ASSOCIATES

Subscription to the TRANSACTIONS is optional with Associates.

| | | | |
|---|---|---|---|
| Dues of Associates | $12.00 | $12.00 | $12.00 |
| TRANSACTIONS in paper, add | | 3.00 | 3.00 |
| TRANSACTIONS in standard binding, add | | | 2.00 |
| Total | $12.00 or | $15.00 or | $17.00 |

### JUNIOR ASSOCIATES

Dues of Junior Associates entitle them to the monthly publication, MINING AND METALLURGY, but do not entitle them to the TRANSACTIONS. Junior Associates may purchase TRANSACTIONS at $2.50 per volume.

| | | | |
|---|---|---|---|
| Dues of Junior Associates | $ 6.00 | $ 6.00 | $ 6.00 |
| TRANSACTIONS, in paper, add | | 5.00 | 5.00 |
| Bound TRANSACTIONS, add | | | 2.00 |
| Total | $ 6.00 or | $11.00 or | $13.00 |

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## The Year Book

THE year book is one of the most valuable publications of the Institute. Whatever may happen to other publications, the year book lies on our desks the year around, to be consulted at frequent intervals and to be stained with many a thumb mark.

Its value, however, depends on the hearty coöperation of every member. From 30 to 50 per cent. of our members change their engagements or their addresses every year. Our master file is kept up to date every day of the year and is as near perfect as it is possible for us to keep it, and yet errors creep in. Some, no doubt, occur in the Institute office, but more occur through members neglecting to tell us of new positions, changes in title or some slight change in address.

The 1923 year book will go to press early in the new year. If mail is being improperly addressed or if a change in title is desired, please advise the Membership Department as soon as possible after reading this notice.

F. F. S.

## Résumé of November Directors' Meeting

THE meeting of the Board of Directors was held at Institute headquarters, Nov. 17, the following being present: W. H. Aldridge, Percy E. Barbour, George D. Barron, W. H. Bassett, Galen H. Clevenger, W. M. Corse, Arthur S. Dwight, Archibald Douglas, H. B. Fernald, Alfred D. Flinn, B. B. Gottsberger, W. Spencer Hutchinson, James F. Kemp, A. R. Ledoux, Robert Linton, Professor de Margerie, Paul D. Merica, H. G. Moulton, R. V. Norris, Charles F. Rand, J. V. W. Reynders, H. Ries, F. F. Sharpless, Bradley Stoughton.

Minutes of the previous meeting were approved and the report of the Treasurer and Finance Committee submitted in mimeographed form, accepted and filed.

The candidates recommended by the Membership Committee were elected.

The proposed change in the By-laws relative to Library Committee and the stock of publications on hand was not voted on because of the lack of the necessary number of Directors required.

The minutes of the meeting of the Joint Finance Committee submitted in mimeographed form were approved.

The question of changing the price charged members for binding back volumes of TRANSACTIONS was referred to the Executive Committee with power.

A request from the "Sentinels of the Republic" for the use of the addressograph was declined.

To fill vacancies occurring by the expiration of terms in 1923 by representatives of the A. I. M. E. on joint activities, the following were elected: Trustee of the United Engineering Society, J. V. W. Reynders; Member of the Library Board, Robert Linton; Engineering Foundation, Arthur L. Walker; John Fritz Medal Board of Award, Charles F. Rand; American Engineering Standards Committee, George E. Thackray.

Resignation of Edwin Ludlow as trustee of the United Engineering Society necessitated the filling of this vacancy temporarily; Arthur S. Dwight was elected.

The board voted to endorse Dr. George K. Burgess for director of the Bureau of Standards, which position is vacant.

The matter of printing the report of the Committee of the A. I. M. E. on Federal Taxation of Mines, dated Oct. 21, 1919, in the TRANSACTIONS was referred to the president with power, as were also the invitations from the A. I. M. E. to members of the Institution of Mining and Metallurgy and the Institution of Mining Engineers, both of London, to attend our February meeting.

The dropping of members who have not paid their dues was referred to the Executive Committee with power.

Votes of thanks were extended to the San Francisco Section and all the other sections visited by the Institute party on its trip West in September and October.

The rules of award for the Douglas Medal were adopted as submitted.

## Exchange Greetings

THE two following cablegrams were exchanged last month at the time of the memorable banquet held by the mining engineers in London:

New York, Nov. 15, 1922.

Please present to your two societies on the occasion of your joint banquet heartiest greetings from the American Institute of Mining and Metallurgical Engineers and best wishes for returning prosperity to the great industry of mining.

DWIGHT, President.

London, Nov. 16, 1922,

The Prince of Wales, American Ambassador, and company-eight hundred assembled at dinner, Guild Hall, London, of Insti. tute Mining Metallurgy and Institution Mining Engineers send cordial greetings. Good wishes to members profession in United States.

CHARLES MCDERMID, Secretary.

The Board of Directors having spread these on the minutes at the last meeting, authorized the president to prepare invitations to the two English institutions to send representatives to our annual meeting in February, 1923.

## Members Going Abroad

MEMBERS of the Institute contemplating visiting Europe are advised that by communicating with the Secretary useful letters of introduction may be obtained—and at the same time opportunities of service to the Institute may be availed of, particularly in the direction of carrying forward the mission of establishing the world-wide fraternity of the engineering profession.

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# Local Sections and Affiliations

## Local Section Meetings

**Boston.**—Meets first Monday of each winter month.

**Columbia.**—Holds four sessions during year. Annual meeting September or October.

**New York.**—Meets first Wednesday after first Tuesday of each month.

**San Francisco.**—Meets second Tuesday of each month.

## Columbia Section Endorses Nomination

ABOUT twenty members of Columbia Section met at noon on Nov. 3, at the Davenport Hotel, Spokane. Vice-chairman F. M. Smith presided.

The secretary announced the nomination of F. M. Smith as vice-president and director of the Institute, from District 11, and on motion, it was unanimously voted to send the thanks of the members of Columbia Section to the Nominating Committee of the Institute.

John T. Lund, president of the Northwest Lead Co., of Seattle, made a brief address on the scope of manufacture and distribution of the products of his company. Using Bunker Hill lead, which is 99.99 per cent. fine, the company manufactures almost every product of pure lead.

## St. Louis Section Field Trip

THE 25th meeting of the St. Louis Section took the form of a field meeting in the fluorspar district of southern Illinois on Oct. 21–22. Thirty-five members took the trip, and the section is deeply indebted to the companies of the district for the opportunities afforded.

Visits were made to the mines and mills of the Rosiclare Lead and Fluorspar Mines and the mill of the Inland Steel Co. During a boat ride on the Ohio River, the geology of the surrounding country was noted. Prof. Steward Weller, of the University of Chicago, and E. C. Reeder gave talks on the geology, mining and milling of the district.

On Nov. 1, the St. Louis Section held a joint meeting with the Associated Engineering Societies of St. Louis, at which Captain B. O. Mahaffey gave an interesting description of some of his experiences in railroad work and exploration in Ecuador.

## Affiliated Student Societies

**University of Alabama.**—The Mining and Metallurgical Society will meet on second and fourth Monday evenings this winter. The officers of the club are: president, R. B. Duggar; vice-president, F. C. Nix; secretary-treasurer, F. L. Kelly.

**University of Arizona.**—The Mining Society is planning to hold regular meetings once a month and extra meetings when speakers are available. The officers are: Ernest Hansen, president; H. M. Taylor, vice-president; George Roseveare, secretary; Charles Foraker, treasurer.

**Colorado School of Mines.**—The Scientific Society held its first meeting this year on Oct. 11. General Bulkeley Wells addressed the students. He told them to honor their profession and they would honor themselves. Addresses were made also by F. G. Farish, manager of the Metals Exploration Co., Lewis S. Noble, consulting engineer, Charles M. Bell, consulting engineer for the Metals Exploration Co., Howard F. Fields, mining engineer with the American Smelting and Refining Co., Herbert Addison, vice-president and manager of the Big Horn Collieries Co., George J. Bancroft, mining engineer of Denver, and F. C. Gilbert, general manager of the American Smelting and Refining Co. Prof. Lester S. Grant spoke to the visitors on behalf of the school. Frank Stortz was elected president; E. Milburn J. Alenius, vice-president; Henry Raymond Lee, secretary.

**Harvard University.**—The officers of the Geological Club for the coming school year are Robert Worthington, president; W. R. McComb, vice-president; Bradford Willard, treasurer; Marland P. Billings, secretary; graduate representative, Gordon Gunther.

**Iowa State College.**—The officers of the Student Branch of the A. I. M. E. for this year are: president, R. L. Wright; vice-president, J. H. Rust; secretary-treasurer, E. F. Koerner.

**University of Kansas.**—The Student Branch of the A. I. M. E. has held two meetings this fall. At the first meeting, Prof. C. M. Young, head of the department of mining engineering, gave a talk on the general condition of the mining industry, with brief reviews of some of the recent literature. At the second meeting, H. A. Waite and W. H. Wynn gave an interesting account of a summer spent in the mines at Butte, where

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the friendliness of graduates of the university enabled them to gain experience in many phases of mining work. One of the most interesting points brought out was the great desirability of training in first aid and mine rescue work, which was impressed upon them by experience in such work. The club holds two meetings each month. Raymond Coté is president; W. H. Wynn, vice-president; H. K. Shane, secretary-treasurer.

**Lafayette College.**—The John Markle Mining Society held its first meeting and election of officers on Oct. 12. The election results were as follows: president, H. I. Cawthra; vice-president, E. Powell; secretary, P. M. Detwiler; treasurer, J. Mac Cartney. The feature of the meeting was an illustrated lecture given by Prof. W. S. Hall on his "Mining Trip Through Europe." Some of the mines described were the salt and lignite of Russia and Poland, the coal of Bohemia and Westphalia, the tin of Cornwall and the copper and silver of the Hartz mines. The slides showed clearly that Europe's mining methods compare favorably with those of the United States and that modern equipment is widely used there. Some of the Freshmen who have had experiences in anthracite coal mines gave interesting accounts of their work.

**Lehigh University.**—The Mining and Geological Society elected its officers on Sept. 28, as follows: president, J. A. Thomas; vice-president, R. T. Hacker; secretary, J. M. Piersol; treasurer, S. C. Hubbard; curators, J. V. Danko and H. R. Randall. Dr. Charles Russ Richards spoke to the students on Science of Engineering and the Engineering Curriculum. Prof. Howard Eckfeldt, head of the mining engineering department, reviewed the history and aims of the society, for the benefit of new members, and urged affiliation with the Institute.

**Lawrence College.**—The officers of the Geological Engineers Club this year are: Carroll A. Phillips, president; Carl R. Swartzlow, vice-president; Homer M. Hunt, secretary-treasurer. The club meets on the second and fourth Thursdays of the month.

**University of Minnesota.**—The School of Mines Society's officers are: George Hezzlewood, president; Henry La Tondresse, vice-president; Barnard Hutchinson, secretary-treasurer.

**Missouri School of Mines.**—The Mining and Metallurgy Association elected its officers on Oct. 10. They are: president, H. J. Schiermeyer; vice-president, Prof. C. Y. Clayton; secretary, H. S. Pence; treasurer, C. G. Bowers. H. J. Schiermeyer represented the association on the field trip of the St. Louis Local Section of the Institute, Oct. 20–22. On Nov. 1, Prof. H. H. Stoek, of the University of Illinois, addressed the society on the subject of coal storage, and on Nov. 16, L. E. Young, former director of the Missouri School of Mines, spoke to the students. Mr. Young is president of the Union Colliery Co. of St. Louis, and gave a description of the company's new installation at the Kathleen mine, illustrated by slides of the underground workings and surface plant of the company.

**University of Oklahoma.**—The officers of the Pick and Hammer Club are: C. V. Sidwell, president; C. C. Church, vice-president; Ester Eckstedt, secretary-treasurer. There are over fifty members this year, and the club is planning some worthwhile things along geological lines.

**Oregon Agricultural College.**—The Miners' Club of the School of Mines has begun its year by electing John H. Quiner as president; A. E. Stogard, vice-president; D. Potter, secretary.

**Princeton University.**—The following officers of the Engineering Society have been elected: president, C. S. Wurts; vice-president, S. R. Lee; treasurer, W. C. Margetts; secretary, H. A. Manthai.

**University of Toronto.**—At the first meeting of the Mining and Metallurgy Club, the following officers were elected for the coming season: honorary president, Prof. H. E. T. Haultain; president, W. S. Maguire; vice-president, G. C. Mutch; secretary-treasurer, A. G. Horning; second year representative, W. Hansen; first year representative, S. Dickson; chairman entertainment committee, J. G. Ironsides.

**University of West Virginia.**—The Mining Society is planning to hold meetings every two weeks, and to have three papers presented at each meeting by members of the society; also, twice in each semester, to join with the other affiliated societies in a general meeting at which two papers will be presented by each society. The officers of the society this year are: Homer L. Chalfant, president; W. S. Moore, vice-president; Paul H. Williams, secretary; E. B. Hutchinson, treasurer; A. C. Gibbons, publicity agent.

**Case School of Applied Science.**—Officers of the Pick and Shovel Club are: G. C. Graf, president; F. F. Criley, vice-president; J. K. Johnson, treasurer; J. C. Hodge, secretary. Regular meetings will be held on third Wednesdays, and special meetings will be called when occasion arises. It has been decided to confine the addresses at the regular meetings, so far as possible, to plant management, welfare work, safety work, salesmanship, etc., as these subjects are not covered by the curriculum of the school. For discussion of more technical subjects, the club will take advantage of the invitation of the local section in Cleveland to attend its meetings.

**University of California.**—The officers of the Mining Association are John Metz, president; Henry L. Day, vice-president; Harold E. Linney, treasurer; Vic E. Bramming, secretary; Gloyd M. Wiles, sergeant-at-arms. The Mining Association gave a dance for the benefit of the families of the miners who lost their lives in the Argonaut disaster, from which $325 was cleared.

**South Dakota State School of Mines.**—The Drill and Crucible Club has elected the following officers:

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president, Stewart Bryant; vice-president, Everett Johnson; secretary-treasurer, A. I. Johnson.

## Woman's Auxiliary

OWING to the absence in Europe of Mrs. H. W. Hardinge, president, the monthly meeting of the W. A. A. I. M. E. was held on Oct. 19 instead of on Oct. 5. Eleven members were present.

### Reports of Sections

Northern California Section reported that Mrs. F. W. Bradley had been appointed chairman in the place of Mrs. Edmund Jüssen, resigned.

The secretary read a telegram from the chairman of the Massachusetts Section, saying that this section desires to have local option in the collection and handling of dues and initiation fees. The secretary was instructed to write to Mrs. Richards informing her that a committee had been appointed to draft, and send out to all sections, a letter explaining the proposed change in By-Law No. 8 regarding collection of dues.

St. Louis Section has raised $75.50 for the Scholarship Fund.

The Anaconda Section raised $750 on Tag Day for the Milk Fund, which supplies 60 children with milk during the summer and will supply a larger number during the winter. This section voted to abide by By-Law No. 8 regarding the collection of dues. Mrs. Forrest has been appointed secretary of the Anaconda Section.

The new Michigan Section reported the appointment of Miss Eleanor S. Brown, of Franklin Furnace, N. J. as its representative.

### Reports of Committees

The scholarship given jointly by Columbia University and the Woman's Auxiliary has been awarded to Ray S. Jones, of Bozeman, Mont., who is now a student at the School of Mines, Columbia University, with advanced standing in chemistry. It has been necessary for the Berkeley student to pay the extra fees of non-resident students, an obligation which the Educational Fund Committee has assumed.

The response to the idea of the Educational Committee has been so generous throughout the sections that the committee has decided to offer another $500 scholarship to take effect from February, 1923.

Mrs. Dwight, chairman of the Membership Committee, reported having spoken to eight sections in the West about the manner of payment of dues and ascertained that the sections generally prefer local option in this matter. The chairman of the Membership Committee was instructed to compile, print and circulate to all members a new membership book.

Mrs. Sharpless, chairman of the Press Committee, made no report, but referred to the account of the section meetings throughout the West as given in Mining and Metallurgy for October and November.

A motion was made and seconded that a vote of thanks be extended to all members of the W. A. A. I. M. E. who so graciously and hospitably entertained the women who were members of the president's party attending the San Francisco meeting.

Mrs. Raymond, chairman of the Chest Committee, reported the receipt of a telegram from Mr. Huntoon, from Cobalt, Ont., asking that the Woman's Auxiliary send some clothing to the sufferers from the recent terrible forest fires in Cobalt and Haileybury. It was decided that the contents of the chest—117 garments—be sent at once by the New York Section for distribution by Mrs. Tyrrell of Toronto. Mrs. Westervelt offered her apartment, 1 Lexington Avenue, for the use of the Chest Committee for its sewing meetings to be held the 2nd and 4th Tuesdays, until Lent, at 2 o'clock. This offer was gratefully accepted.

### November Meeting

The regular meeting of the Board of Directors was held on Nov. 2, eleven members being present.

Letters from Mrs. E. F. Brown, chairman of the new Vulcan Section and from Mrs. Siebenthal, chairman of the Charity Committee, told of the establishment of a class of foreign born girls in charge of Mrs. Brown and garments given to needy families.

An enthusiastic letter from Mrs. F. W. Bradley read in part as follows:

> We attribute the largest attendance recorded, at a meeting held at the Clift Hotel, to the interest occasioned by our delightful visitors who inspired us all during those happy days when the A. I. M. E. met in our city. The treasurer, Mrs. Morley, reported a small balance in the treasury and $54 in the Study Room Fund, to which Mrs. Hardinge had generously contributed $25, which was to be used for the purchase of a lamp for the room. Letters were read from Mrs. Hardinge showing her usual enthusiasm and interest in the San Francisco Section. Many references were made throughout the meeting to our guests from New York who brought us so much of the spirit of service, earnest devotion and belief in the work of the Auxiliary.

A letter from Mrs. Croasdale, secretary of the Colorado Section, referred to "our splendid visit with Mrs. Hardinge in the summer" and attributed the new enthusiasm in the section to her stimulating talks. The Chest Committee holds a meeting on third Wednesday afternoons and is now sewing for the Visiting Nurse Association. The Educational Fund is taken care of in the budget. A committee was appointed to visit and keep in touch with any engineers who may be patients in the Government Hospital in Denver.

Letters were read from Mrs. Billings and Mrs. Moore of the Northern Arizona Section, referring to the recent visit of the women of the president's party as being "of real inspiration" to the women of that section.

Mrs. R. L. Lloyd is chairman of the Chest Committee, Mrs. Raymond having resigned.

It was ordered that the Library Committee be made a national instead of a local committee, with a representative on the Board of Directors.

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# Government Papers of Interest to Engineers

## Investigations by the Bureau of Mines*

**Experiments in Underground Signalling with Radio Sets** (Serial 2407; 4 pages). By C. L. Colburn, C. M. Bouton, and H. B. Freeman.—The mine telephone has been perfected to such an extent that it is giving satisfaction in most mines where the wiring is well insulated, but in the event of a disaster it frequently happens that the mine telephone system is put out of commission by the agency that causes the disaster, at the time when it is most urgently needed. Many requests have been received by the Bureau of Mines to devise means of utilizing wireless methods for this purpose. The results of some preliminary experiments conducted by the writers at the Bureau of Mines experimental mine at Bruceton, Pa., in the ordinary sending and receiving of radio waves through earth strata are described in this paper. The experiments were made in coöperation with the Westinghouse Electric and Manufacturing Co., which assigned to this work three of its radio engineers, C. A. Boddie, E. C. Douglas, and F. D. Fessler.

These preliminary experiments, while unsuccessful in indicating any practical method of using wireless waves for underground communications, indicate clearly that electromagnetic waves may be made to travel through solid strata. The "absorption," or loss of intensity with distance, is very great for the short wave lengths used in these experiments. Longer wave lengths are known to suffer less absorption and may possibly be found practically effective under certain conditions.

* Reports in full may be obtained from the Director of the Bureau of Mines, Washington, D. C. Give serial number.

**Explosion-proof Electrical Equipment** (Serial 2398; 2 pages) By L. C. Ilsey.—Ten reasons why permissible equipments approved under schedules 2B and 15 are safer than unapproved types.

**Summary of Investigations of Dust and Ventilation in Metal Mines** (Serial 2374; 2 pages). By D. Harrington.—The title indicates the contents of this paper. A four-page bibliography is appended.

**Rate of Reduction of Hematite to Magnetite by Methane** (Serial 2381; 9 pages). By C. M. Bouton.—While studying the reduction of iron oxides by fuel gases in the Pacific experiment station of the Bureau of Mines, E. D. Eastman noted that methane seemed less reactive than other gases, particularly hydrogen and carbon monoxide. Experiments were planned for the purpose of finding under what conditions of time of contact the methane would become effective as a reducer. They consisted in passing a stream of mixed hydrogen and methane through a layer of iron oxide and, by analysis of the outflowing gases, determining the proportion of each type of gas that has reacted. Eastman's observation as to the inactivity of methane as compared to hydrogen is confirmed. Only the reduction of hematite to magnetite has been studied; the reduction to FeO or to metal has not received attention in this series of experiments.

**White Clay Industry in the Vicinity of Langley, South Carolina** (Serial 2382; 6 pages). By W. M. Weigel.—Describes prospecting and mining the clay, general characteristics of the clay, and methods of milling and preparation for market used by three companies.

# Increase of Membership Department

**Total membership as of Nov. 11, 1922, is 10,259**

APPLICATIONS FOR MEMBERSHIP.—**The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any person whom they think should not be classified in accordance with the list given.**

The following persons have been proposed during the period Oct. 15 to Nov. 15, 1922, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

## Candidates for Membership

Members

**1—Charles P. Aicher,** Alma, Colo.
Present position—1914 to date: Manager, London Gold Mines Co.
Proposers: Forbes Rickard, James E. Dollison, C. L. Logue.

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**2—Theodore Harvey Barrett,** Washington, D. C.
Present position—1920 to date: Coal Valuation Engineer, Income Tax.
Proposers: Albert H. Fay, Oscar H. Reinholt, Louis W. Atkinson.

**3—Max Kryno Heinrich Bauermann,** The Hague, Holland.
Present position: Chief Geologist and Representative, Bataafsche Petroleum Maatschappy, for Colombia, S. A.
Proposers: W. H. Whittier, F. A. A. Van Gogh, J. T. Erb, B. H. Vander Linden.

**4—Walter S. Bourlier,** Bethlehem, Pa.
Present position—1914 to date: Chief Engineer, Bethlehem Steel Corp., Mining Dept.
Proposers: W. L. Cumings, J. E. Little, M. L. Jacobs.

**5—David Bradley Carse,** New York, N. Y.
Present position—1907 to date: President, International Engineering & Financing Corpn.
Proposers: Howard N. Eavenson, William Hutton Blauvelt, Otto C. Davidson, Gordon Buchanan.

**6—Martin John Thomas Conway,** Midland, Pa.
Present position—1921 to date: Combustion Engineer.
Proposers: William J. Priestley, William I. McInerney, O. L. Pringle.

**7—Homer Davis Ford,** Watson, Utah.
Present position—1910 to date: Superintendent, Gilson Asphaltum Co.
Proposers: J. M. McClave, Victor C. Alderson, Carl A. Allen.

**8—Edward C. Geither,** Brookline, Mass.
Present position—1921 to date: Manager, Ingersoll-Rand Co. of New England, Boston, Mass.
Proposers: Carl F. Moore, F. W. O'Neil, J. H. Jowett.

**9—James Clyde Gibson,** Wheeling, W. Va.
Present position—1921 to date: Mining Engineer, Wheeling Steel Corporation.
Proposers: R. W. McCasland, D. A. Burt, George W. Gehres.

**10—Herbert Terry Greene,** New York, N. Y.
Present position: Unemployed.
Proposers: E. L. Jorgenson, C. S. Witherell, Hjalmar E. Skougor.

**11—Henry Waldemar Haapanen,** St. Louis, Mo.
Present position—1920 to date: Chief Engineer, West Virginia Coal Co. of Missouri.
Proposers: Guy E. Ingersoll, J. B. Cunningham, F. W. Sperr.

**12—Dilworth Scott Hager,** Houston, Tex.
Present position: Head Geologist for East and Southwest Texas, Gulf Production Co.
Proposers: Waldemar F. Henniger, Wallace E. Pratt, James F. Kemp.

**13—Eugene Atwood Hardy,** Orland, Glenn Co., Cal.
Present position—1911 to date: Land Appraiser, Mining and Hydraulic Engineering, State Licensed Surveyor, Southern Pacific R. R. Co., Land Dept., San Francisco, Cal. Title, Field Agent.
Proposers: M. L. Requa, John H. Leavell, Charles E. Bruff.

**14—Arthur Dickinson Hughes,** Kuala Lumpur, Federated Malay States.
Present position—1919 to date: Examining Engineer, Yukon Gold Co.
Proposers: Edward E. McCarthy, Charles Janin, Ross B. Hoffman.

**15—John Hynd,** Bulawayo, Southern Rhodesia, Africa.
Present position—1902 to date: Consulting Mechanical Engineer, Gold Fields Rhodesian Development Co.
Proposers: J. Chapman, F. Wartenweiler, P. M. Newhall.

**16—Waldemar Arthur Knoll,** Bessemer, Mich.
Present position: Underground Superintendent, Anvil-Palms, Steel & Tube Co. of America.
Proposers: Edwin R. Shorey, C. K. Leith, J. F. Berteling.

**17—John Morton Lee,** London, England.
Present position—1919 to date: Assistant Chief Engineer, The Wilfley Co. Ltd.
Proposers: J. Mitchell-Roberts, R. O. Stokes, J. Thame.

**18—David B. Lesser,** Chicago, Ill.
Present position—1918 to date: Research Engineer, General foreman, Superintendent, General Superintendent, Goldsmith Bros. S. & R. Co.
Proposers: H. B. Pulsifer, Charles G. Murphy.

**19—Louis Williams McKeehan,** New York, N. Y.
Present position—1921 to date: Research Physicist, Western Electric Co.
Proposers: W. A. Scheuch, A. J. Mandell, J. W. Harris.

**20—David McLain,** Wauwautosa, Wis.
Present position: Consultant, Pennsylvania Forge Co., Philadelphia, Pa.
Proposers: John H. Hall, Bradley Stoughton, Charles F. Rand.

**21—George Herbert Norton,** Andes, N. Y.
Present position—1921 to date: Geologist, United States Gypsum Co.
Proposers: Robert H. Hopkins, George O. Williams, Marvin Lee.

**22—Charles Henry Richardson,** Syracuse, N. Y.
Present position: Professor of Mineralogy and Head of Department of Mineralogy, Syracuse University.
Proposers: W. C. Phalen, Louis W. Currier, H. Ries.

**23—George Mackey Roads, Jr.,** Lansford, Pa.
Present position—1919 to date: Superintendent, Panther Valley Water Co., and District Land Agent, Lehigh Coal and Navigation Co.
Proposers: Charles E. Locke, G. B. Hadesty, Herbert D. Kynor.

**24—Vicente Fernandez Soler,** Pachuca, Mexico.
Present position: General Manager, La Luz de Pachuca Mine.
Proposers: Victor M. Braschi, Louis Charles Penhoel, Manuel F. Garrido.

**25—Jose Oscar Trevino,** Chihuahua, Mexico.
Present position—1919 to date: Superintendent of Mines, Prieto Estate.
Proposers. F. W. McNair, Russell B. Paul.

**26—Elry Jay Wagor,** New York, N. Y.
Present position—1920 to date: Superintendent, Melting and Refining Dept., U. S. Assay Office.
Proposers: Galen H. Clevenger, Lawrence Addicks, Marshall S. Walker, E. L. Oliver.

**27—Maurice de Wendel,** Hayange, Moselle, France.
Present position: Vice President, Mining Company of Douchy, Lourches, Pas de Calais.
Proposers: Alexandre Pourcel, E. H. Gary, George G. Crawford.

**28—Lewis F. Wheeler,** Elizabeth, N. J.
Present position—1913 to date: Associate Chemist and Metallurgist, Singer Mfg. Co.
Proposers: Walter S. Dickson, Bradley Stoughton, Sidney Rolle.

**29—Raymond Alonzo Wheeler,** Britannia Beach, B. C., Canada.
Present position—1920 to date: Mine Engineer, Britannia Mining and Smelting Co.
Proposers: William J. Quigly, C. P. Browning, James I. Moore, Jr.

## Associates

**30—Roger Dickinson Carver,** Boston, Mass.
Present position: Helper on Acid Open Hearth, Everett Works of General Electric Co., Everett, Mass.
Proposers: Edward E. Bugbee, Carle R. Hayward, George B. Waterhouse.

**31—Charles Lester Laederer,** Timmins, Ont., Canada.
Present position: Geologist for Bennet-Pore Gold Mining Syndicate and private practice.
Proposers: N. J. Evered, B. M. Walton, W. E. Honer.

**32—Dean Stanford Leick,** Butte, Mont.
Present position: Contract Engineer, Butte Superior Mining Co.
Proposers: E. R. Cullity, E. E. Barker, W. S. Grether.

**33—William Schulman,** Paterson, N. J.
Present position: Unemployed.
Proposers: Charles E. Locke, Carle R. Hayward, Edward E. Bugbee.

**34—Nelson Stanley Spencer,** New York, N. Y.
Present position: Counselor at Law, Spencer, Ordway & Wierum.
Proposers: George S. Rice, Arthur S. Dwight, F. F. Sharpless.

**35—Alfred Werenfels,** Cartagena, Colombia, S. A.
Present position—1921 to date: Geologist, Bataafsche Petroleum Maatschapij.
Proposers: W. H. Whittier, Alfred P. Frey, Ernst Alfred Ritter.

## Junior Associates

**36—Joseph Ira Barker,** Salt Lake City, Utah.
Student, University of Utah.
Proposers: J. A. Norden, S. P. Holt, Robert S. Lewis.

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**37—Philip LeRoy Blake,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: M. H. Thornberry, Charles Y. Clayton, J. R. Guiteras.

**38—Arnold Eugene Borel,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Theodore Simons, A. E. Adami, Horace T. Mann.

**39—John Willard Buch,** Columbus, O.
Student, Ohio State University.
Proposers: H. E. Nold, William J. McCaughey, William A. Mueller.

**40—John Balmer Camm,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Benjamin L. Miller, G. A. Roush, Howard Eckfeldt.

**41—Edward A. Capillon,** New York, N. Y.
Student, Columbia University.
Proposers: William Campbell, Edward F. Kern, Arthur L. Walker.

**42—William Ferd Cerini,** Oakland, Cal.
Student, University of California.
Proposers: Lester C. Uren, Walter S. Weeks, W. S. Morley.

**43—James H. Cairns,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. M. VanTuyl.

**44—Everett Hunter Cathcart,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. L. Dake, C. R. Forbes, M. H. Thornberry.

**45—Arthur Morgan Creighton,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, Benjamin L. Miller.

**46—Thomas Moir Gardiner, Jr.,** Socorro, New Mexico.
Student, New Mexico State School of Mines.
Proposers: E. H. Wells, W. G. Ramlow, Cony T. Brown.

**47—Harold Avery Harris,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. M. VanTuyl.

**48—Wilfred Harvey Johnston,** San Francisco, Cal.
Student, University of California.
Proposers: Walter S. Weeks, Lester C. Uren, W. S. Morley.

**49—William Miller Keeling,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: M. H. Thornberry, Joseph R. Guiteras, C. R. Forbes.

**50—Jack K. Killmer,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, Howard Eckfeldt.

**51—Albert Pascal Kleeman,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, F. M. VanTuyl.

**52—Kenneth Frederick Le Marinel,** Stanford University, Cal.
Student, Stanford University.
Proposers: W. F. Dietrich, Theodore J. Hoover, James M. Hyde.

**53—**Wallis Henry Lee, Butte, Mont.
Student, Montana State School of Mines.
Proposers: Theodore Simons, A. E. Adami, Horace T. Mann.

**54—Joel Longenecker Light,** Allentown, Pa.
Student, Senior Class, Lehigh University, Bethlehem, Pa.
Proposers: Howard Eckfeldt, Benjamin L. Miller, H. B. Pulsifer.

**55. Roy Tarbox Lyons,** Houghton, Mich.
Student, Michigan College of Mines.
Proposers: F. W. Sperr, J. B. Cunningham, Guy E. Ingersoll.

**56—Armor Beardslee Martin,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, J. J. Lillie, Lester S. Grant.

**57—Aloysius J. Moran,** Butte, Mont.
Student, Montana State School of Mines.
Proposers: Theodore Simons, A. E. Adami, Horace T. Mann.

**58—Alan Morris,** New York, N. Y.
Student, Columbia School of Mines.
Proposers: William Campbell, R. M. Raymond, E. J. Hall.

**59—Frank Mulford,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, Charles Y. Clayton.

**60—William Miller Naughton,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, Benjamin L. Miller.

**61—Oliver Peter Nicola, Jr.,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: Benjamin L. Miller, Howard Eckfeldt, A. Henry Fretz.

**62—John Milton Reeves,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, C. R. Forbes, B. M. O'Harra.

**63—Irvin Sterner Reiter,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Howard Eckfeldt, Allison Butts.

**64—Walter Edward Remmers,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: M. H. Thornberry, Charles Y. Clayton, Francis B. Foley.

**65—George H. Roseveare,** Tucson, Ariz.
Student, University of Arizona.
Proposers: G. M. Butler, T. G. Chapman, J. Kruttschmitt, Jr.

**66—Morris Schapiro,** Brooklyn, N. Y.
Student, Columbia School of Mines.
Proposers: R. M. Raymond, H. A. Guess, James F. Kemp.

**67—Harry John Schiermeyer,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: Charles Y. Clayton, M. H. Thornberry, C. R. Forbes.

**68—Olin Curtis Sheetz,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, Benjamin L. Miller.

**69—Raymond E. Speare,** Socorro, N. M.
Student, New Mexico State School of Mines.
Proposers: E. H. Wells, W. G. Ramlow, Cony T. Brown.

**70—David Arthur Ralph Thompson,** Socorro, New Mex.
Student, New Mexico School of Mines.
Proposers: E. H. Wells, Cony T. Brown, W. G. Ramlow.

**71—Adolph Gustave Wethrich,** Bethlehem, Pa.
Student, Lehigh University.
Proposers: G. A. Roush, Allison Butts, Benjamin L. Miller.

**72—Augustus Benton Wilkerson, Jr.,** Rolla, Mo.
Student, Missouri School of Mines.
Proposers: C. R. Forbes, J. R. Guiteras, Charles Y. Clayton.

**73—John Bogan Yates,** Golden, Colo.
Student, Colorado School of Mines.
Proposers: J. C. Roberts, Lester S. Grant, F. M. VanTuyl.

### Change of Status—Associate to Member

**74—Charles Albert Warner,** Okmulgee, Okla.
Present position—1921 to date: Geologist and Representative, Houston Oil Co. of Texas, Houston, Tex.
Proposers: Arthur W. Duston, W. E. Bernard, S. W. Wells.

### Change of Status—Junior Associate to Member

**75—George M. Cheney,** Potrerillos, Chile, S. A.
Present position—1920 to date: Engineer, Andes Copper Mining Co.
Proposers: L. A. Callaway, N. F. Koepel, Louis F. Clark.

**76—Eugene N. Hogan,** Butte, Mont.
Present position—1920 to date: Assistant Foreman, Emma Mine, Anaconda Mining Co.
Proposers: Lee Hayes, Bancroft Gore, C. H. Bowman.

**77—William Smith Livingston, Jr.,** New York, N. Y.
Present position: Unemployed.
Proposers: E. J. Hall, Robert Peele, W. B. Montgomery, James F. Kemp.

### Change of Status—Junior Associate to Associate

**78—Roscoe H. Clarke,** Congo Belge, W. Africa.
Present position—1921 to date: Forminiere Agent, Kassai Region.
Proposers: Harry J. Wolf, H. G. St. Clair, Robert H. Sayre.

**79—John M. Schloss,** New York, N. Y.
Present position: Engineer, Department of Docks.
Proposers: Frederick W. Osborn, William R. Grunow, Henry S. Burnholz.

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# Engineering Societies Library

HARRISON W. CRAVER, Director

## Book Reviews

**Handbook of Chemical Engineering.** Edited by Donald M. Liddell. New York, McGraw-Hill Book Co., Inc., 1922. 2 vols., 1008 pp., illus., diagrs., 6 × 9 in., Flexible Keratol, $8.

The editor of this book, Donald M. Liddell, chemical and metallurgical engineer, is the author of "Chemists' and Metallurgists' Handbook," of which the second edition is now exhausted. The essential features of the chemical industry are described in this book by specialists in the various fields. It is the most painstaking and ambitious attempt to cover this very large field which has been made. This will be seen from the table of contents, which comprises the following subjects:

Vol. 1.—Generation and Transmission of Power; Material Handling—The Transportation of Solids; The Transportation of Liquids; The Transportation of Gases; Crushing and Grinding; Grading (Sising and Screening); Mechanical Separation; Concentration; Leaching and Dissolving; Evaporation and Drying; Crystallisation; Thermometry and Pyrometry; Refractories.

Vol. II.—High Temperature Production; Mixing and Kneading; Sampling; Fermentation; Distillation—Fractional—Destructive; Refrigeration; Oxidation and Reduction; Electrochemistry; Catalysis; Colloidal Chemistry; Smelting—Zinc—Lead—Copper—Iron—Roasting; Lutes and Cements; Radio-Active Elements; Rare Metals; Rare Gases; Materials of Construction; Plant Design; Methods of Financing.

The tendency in compiling comprehensive books on this very large subject has been to throw together hastily a lot of catalog material and cuts. Such a book, this one distinctly is not. The original articles by the various contributors contain much new and original material besides the résumé of the best practice on the subject. The book is replete with tables and curves, as well as diagrams and illustrations.

The title of the book is a proper title, so far as the chemical industry is concerned, but it fails to reveal to the other branches of engineering, metallurgical and otherwise, the points of contact. There are sixteen chapters in the book that are of important interest to other engineers than chemical engineers. Regarding the rare elements of gases and radium, it contains the latest authoritative information published. The work constitutes a very valuable reference book for metallurgical and construction engineers outside of the chemical field.

P. E. B.

**Blast Furnace and the Manufacture of Pig Iron.** By Robert Forsythe. Third edition revised by C. A. Meissner and J. A. Mohr. N. Y., U. P. C. Book Co., 1922. 371 pp., illus., diagrs., tables, 6 × 9 in., cloth., $4.

In the last preface the author wrote before his death he stated that it was his opinion "that recent writers on iron metallurgy had addressed themselves too exclusively to those who are already versed in its mysteries." This book is designed primarily for the student or one unfamiliar with the art. The revisers are men of note in the profession and amply able to attempt the task. Mr. Mohr is a blast-furnace man experienced in the practice in both this country and Canada, as is also Mr. Meissner, who is now a member of the staff of the president of the U. S. Steel Corporation.

The book treats of the following topics by chapter: materials of manufacture, description of plant, operation of the furnace, burdening the furnace, action within the furnace, furnace irregularities, furnace design and equipment, uses of pig iron and conversion methods, some principles of chemistry and physics.

The book is considered, by those fitted to judge, the best book in its field for those beginning the study of the manufacture of pig iron.

M. R. P.

## Book Notices

**Cements, Limes and Plasters.** By Edwin C. Eckel. Second edition. N. Y., John Wiley & Sons, Lond., Chapman & Hall, 1922. 655 pp., illus., diagrs., maps, tables, 6 × 9 in., cloth. $6.50.

A summary covering the composition and character of the raw materials used for cementing structural materials, the methods of manufacturing the latter and their properties. Pays especial attention to the chemical and physical processes underlying the manufacturing methods, but also discusses costs, output, etc. The new edition has been extensively revised and one hundred pages added, chiefly relating to Portland and magnesian cements and gypsum products.

**Condensed Catalogues of Mechanical Equipment.** 12th Annual, 1922. N. Y., American Society of Mechanical Engineers, 1922. 622 pp., illus., 9 × 12 in., fabrikoid. $5.

The twelfth issue of this convenient reference book appears in new form, the book now having a 7 by 10-in. type page and being printed on thin India paper and bound in flexible covers. In other ways the volume follows the plan of previous years. It contains catalog information, condensed, uniformly presented and illustrated, about the products of 372 manufacturers of mechanical equipment; a classified directory of manufacture of equipment, in which 4200 firms are listed under 3300 headings; and a directory of consulting engineers, containing the names and addresses of 1000 engineers, under 400 headings. In each of these divisions the new issue shows enlargement and thorough revision.

**Elementary Determinants for Electrical Engineers.** By Herbert P. Few. Lond., S. Rentell & Co., Ltd.; N. Y., D. Van Nostrand Co., 1922. 98 pp., 5 × 7 in., cloth, $1.50.

This material appeared originally as articles in *Electricity*, the aim of the writer being to emphasize the advantages that the methods of determinants possess over ordinary algebraic processes for solving many types of problems of interest to electrical engineers. Examples are given dealing with testing, telephony, telegraphy, power distribution, cable balancing, etc.

**Examination of Hydrocarbon Oils and of Saponifiable Fats and Waxes.** By D. Holde. 2d English edition translated from the 5th German edition by Edward Mueller. N. Y., John Wiley & Sons; Lond., Chapman & Hall, 1922. 572 pp., illus., tables, 6 × 9 in., cloth. $6.

This manual offers the oil chemist, in one compact volume, general methods for investigating oils, petroleum and petroleum products, lubricants, natural asphalt, ozocerite, tars from various bituminous materials, saponifiable fats and industrial products prepared from them, and waxes. This edition has been practically rewritten. Many completely new sections on special oils have been introduced, practically all chapters have been fundamentally revised and much information included on the substitutes for oils and fats used by the German oil industry during the war.

**Graphic Charts in Business.** By Allan C. Haskell. First edition. N. Y., Codex Book Co., 1922. 250 pp., charts, 6 × 9 in., cloth, $4.

A companion volume to the author's earlier book, "How to Make and Use Graphic Charts." The present work deals with charts most used for business purposes, line, bar, circular percentage, organization, trilinear and probability

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charts. Methods of making are explained; adaptability for various purposes is set forth, and application in various departments of business organizations illustrated. The ratio chart is explained fully. A bibliography is included. The book is intended to help the man of business see when and how graphic charts can serve his purposes in controlling business operations.

**Handbook of Casinghead Gas.** By Henry P. Westcott. 3d edition. Erie, Pa., Metric Metal Works, 1922. 642 pp., illus., tables, 5 × 8 in., cloth. $3.75.

The author of this work has endeavored to collect, in one volume of convenient size, all the chemical, physical, and engineering information upon the extraction of gasoline from natural gas which is likely to be needed by the man in the field. It treats of the examination and leasing of gas wells, determination of their capacity and the gasoline content of the gas, gathering lines, measuring gas, compression, absorption, blending, transportation, etc. Although few radical changes in method have been developed since the preceding edition of the book appeared, many minor improvements have been made which are now described.

**Handbook of the Petroleum Industry.** By David T. Day. N. Y., John Wiley & Sons; Lond., Chapman & Hall, 1922. Illus., diagrs., tables, 6 × 9 in., fabrikoid. $15.

Contents: The occurrence of petroleum, by Frederick G. Clapp.—Field methods in petroleum geology, by Frederic H. Lahee.—Oil-field development and petroleum production, by Louis C. Sands.—Statistics of petroleum and natural gas production, by Annie B. Coons.—Transportation of petroleum products, by Forrest M. Towl.—Characteristics of petroleum, by David T. Day.—Petroleum testing methods, by T. G. Delbridge.—Natural-gas gasoline, by H. C. Cooper.—Asphalt, by R. G. Smith.—Oil shale, by David E. Day.—Refining, by A. D. Smith.—Cracking processes, by Roland B. Day.—Use of fuel oils, by W. N. Best.—Internal combustion petroleum engines, by Arthur H. Goldingham.—Lubrication, by John D. Gill.—Pipe standards and use of pipe, by F. N. Speller.—General tables.—Current petroleum literature.—Glossary.—Index.

The scope and authoritativeness of this work are shown by the contents and contributors. It is written with especial reference to the engineers who produce and refine oil, but is also addressed to the public interested in the increase of production and the better utilization of our oil supply. Throughout the book attention has been directed to present conditions, and historical matter has been omitted.

**Hydraulic Diagrams for the Discharge of Conduits and Canals.** By Theodore Horton and C. H. Swan. Third edition. N. Y. and Lond., McGraw-Hill Book Co., 1922. 53 pp., diagrs., 6 × 9 in., paper. $1.

A set of diagrams intended for use in the study of the sections of conduits and canals commonly used in sewerage, water supply, water power and drainage. The set includes conduits of ten different types of cross-section and canals of rectangular and trapezoidal cross-section. In this edition one diagram previously used has been replaced by three new diagrams of more useful types, and the text has been revised and extended.

**Hydraulics.** By Horace W. King and C. O. Wisler. N. Y., John Wiley & Sons; Lond., Chapman & Hall, 1922. 237 pp. diagrs., 6 × 9 in., cloth. $2.75.

Deals with the fundamental principles of hydraulics and their application in engineering practice. Though many formulas applicable to different types of problems are given, the aim has been to bring out clearly and logically the underlying principles that form the basis of such formulas rather than to emphasize the importance of the formulas themselves. Intended as a text for beginners and a reference book for engineers interested in the fundamental principles.

**Metallurgical and Analytical Applications of the Spectrograph.** London, Adam Hilger, Ltd., 1922. 12 pp., 6 × 9 in., paper.

This brochure contains three fine photogravures showing the arc spectra of pure lead, pure copper and lead and copper in combination. The accompanying text discusses the application of the spectrograph in metallurgy and chemical analysis. A bibliography on quantitative spectrum analysis is included.

**Oil Encyclopedia.** By Marcel Mitzakis. N. Y., John Wiley & Sons; Lond., Chapman & Hall, 1922. 551 pp. 5 × 9 in., cloth, $6.

This encyclopedia covers a wide range of information interesting to those engaged in the oil industry. Brief articles are devoted to engineering and geological subjects, localities where oil occurs, commercial information, and the history of the industry. A brief bibliography is included.

**Die Statik Des Kranbaues.** Von W. Ludwig Andrée. Dritte auflage. München, R. Oldenbourg, 1922. 370 pp., diagrs., 7 × 10 in., paper, 348 mk.

Eighty examples of static calculations for cranes and similar structures. Includes traveling, cantilever, bridge, rotary, gantry, portal, floating, tower and shipbuilding cranes, aerial ferries, cableways, hoist frames, inclined bridges, grab buckets, swing and bascule bridges. This edition is apparently a reprint of the second.

**Structural Problems.** By C. R. Young. 2nd ed. Toronto, Engineering Society of the University of Toronto, 1922. 96 pp., diagrs., 6 × 9 in., paper, $2.

Typical problems in the design of steel and timber structures, prepared to assist students in elementary structural design and used in the author's classes at the University of Toronto as guides in the preparation of similar designs. The problems do not constitute a systematic development of the subject, but indicate the method of applying structural theory to the design of a number of simple structures and members. Intended to supplement lectures and textbooks.

**Study of Geological Maps.** By Gertrude L. Elles. Cambridge, Eng., University Press, 1921. (Cambridge Geological Series). 74 pp., plates, diagrs., maps, 7 × 10 in., cloth, $4. (Gift of Macmillan & Co.)

Intended to direct the attention of students to the fundamental principles of geological map-reading, and to show what can be obtained from maps when read intelligently.

# Employment Service Bureau

**Under joint management of the national societies of Civil, Mining, Mechanical and Electrical Engineers**

Notices for this column are not acknowledged by letter. Notices received before the 15th of the month will appear in the next issue.

Correspondence relating to replies to advertisements returned to the Employment Bureau will be held in the Bureau one month.

The Employment Service Bureau sends a weekly bulletin, giving lists of positions vacant, to secretaries of local sections and also to secretaries of affiliated student societies.

## Engineers Available

**No person other than a member of one of the four Founder Societies will be registered with the Employment Bureau under this heading.**

**Metallurgical Engineer,** technical graduate, specialized in production of steel casting by electric furnace process. Practical experience in every phase of the work pertaining to the production of steel casting. Has seen modern steel foundry constructed equipped and put into operation. Unmarried. Age 25. Employed at present in western Pennsylvania city. IM–1668.

**Experienced Purchasing and Shipping Agent** mining industry desires connection on commission or fee basis. All inquiries for materials given prompt personal attention. Foreign shipments supervised. IM–1669.

**Metallurgist.**—Age 26. 1919 graduate. Three years experience in research including metallography, physical testing and pyrometry of steel and non-ferrous metals; also automotive research and shop practice. Desires permanent connection. IM–1670.

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**Recent Metallurgical Engineering Graduate** with Master's degree desires position with a metallurgical concern either in research or operative work leading to sales or executive work. Has had some experience in research and general experience in the iron and steel industry. IM–1671.

**Manager.**—Mining Engineer, a young technical graduate, experienced in various labor jobs around mines and mills, and six years in responsible charge of operations; desires position as assistant to the general management of a large organization, where broad experience and advancement can be gained. IM–1672.

**Geologist and Palaeontologist.**—Graduate of Lehigh and Harvard universities; experience in East in invertebrate palaeontology and stratigraphy; will teach geology and allied subjects in university or college; museum work and other positions considered. Salary at least $2000 per year. Age 28. IM–1673.

**Mining Engineer.**—Graduate. Speaks Spanish. Twelve years general metal-mining experience. Draftsman, designer on mine and metallurgical plant work, assayer, chemist, some experience prospecting and examination of small mines. Over four years as engineering assistant to manager of large copper company. Prefers position as assistant to examining engineer superintendent or manager. IM–1674.

**Oil Geologist.**—Princeton graduate, with experience in Mid-Continent fields desires position with oil company or mining firm. Age 31. IM–1675.

**Engineer** with large experience in chemical and metallurgical work desires part time employment, preferably evenings, near New York City. IM–1676.

**Mexico and Central America.**—Information supplied on industrial, commercial and engineering conditions and markets; connections established; trade surveys directed, opportunities located by engineer and trade adviser thoroughly familiar with countries, people and language. Influential connections throughout territory. IM–1677.

**Mining Engineer.**—Graduate. Seven years broad experience in metal mining in this country and South America. Foreman to manager and chief engineer. Operation and examination. IM–1678.

**Mining Engineer.**—Graduate. Two and one-half years bituminous experience. One year oil work. Prefer West or Southwest metal-mine position but willing to go anywhere. Age 31. Married. IM–1679.

**Petroleum Geologist.**—Two years practical experience in Oklahoma, Texas, Kansas, Colorado, New Mexico and Arkansas. B. S. in Mining Engineering in 1920. IM–1680.

**Metallurgical Engineer.**—Open for sales or business position. Practical experience in metallurgy and also in salesmanship and business. IM–1681.

**Executive Mining Engineer.**—Five years experience in railroad location, construction, and general construction. Three years in developing, equipping, and managing mines. Good record as to efficiency and friendly relations with men. Age 40. Married. IM–1682.

**Mining Engineer,** college man, six years metallurgical plant, laboratory and field experience. Excellent knowledge of Soviet Russia and Russian languages. At present prepared to accept any suitable job in engineering line with a good concern, even at moderate salary. Vicinity of New York preferred, but not essential. IM–1683.

## Positions Open

**Persons applying for any of the following positions will please place their names, addresses and initials of the society to which they belong (A. S. C. E., A. I. M. E., A. S. M. E. or A. I. E. E.) on the outside of the envelopes containing the applications.**

**Engineer** to take charge of erection and operation of plant refining mixture of lead and antimony carrying a quantity of silver. Apply by letter. V–1633.

**Electrical Engineer.**—This year's graduates to enter engineering department through drafting room. Apply by letter, giving experience in detail, sample of lettering and photo. Western Pennsylvania. V–1634.

**Sales Engineer.**—A business-getting salesman to sell the capacity of grey iron and malleable iron foundries. Thorough knowledge of foundry practice and extensive experience selling this type of product. Traveling, principally in New England and New York State. Apply by letter. Upper New York State. V–1828.

**Engineer** having some or all of following qualifications: experience in design of industrial electric furnaces; experience in application of industrial electric furnaces; general metallurgical and industrial experience to enable engineer to apply industrial electric furnaces after brief special training. Apply by letter. Pennsylvania. V–1894.

**Graduate Mining Engineer** with broad mechanical experience for diatomaceous earth plant in N. W. United States. Age 30 to 40. Willing to do drafting and layout of equipment; also to install and operate plant. Milling experience essential. Apply by letter. Oregon. V–1896.

**Technical Engineer** with good command of English to prepare research data for press. New York City. V–1970.

**Civil or Mining Engineer** to take charge of party making topographical survey for water supply. Apply by letter. New York State. V–1972.

**Mining Engineer,** 24 to 30 years old, single, for alluvial diamond mining. Apply by letter. Africa. V–2060.

**Mine Superintendent** of talc mines familiar with non-metallic or coal mining. Technical graduate. Apply by letter. Vermont. V–2080.

**Expert Accountant** for mining property in Nevada including a large construction job which is just being initiated. Single man preferred. Apply by letter. V–2094.

**Mill Man** familiar with the Lane slow-speed Chilean mill operating on gold ores where amalgamation and concentration follow. Apply by letter, giving full particulars in first letter. New Mexico. V–2143.

**Inspector** for Shandaken tunnel. Concrete or tunnel work experience. New York State. V–2145.

**Superintendent** of foil plant with rolling mill experience. Apply by letter. New York City. V-2197.

**Engineer** with thorough experience in hydraulic mining, as well as turbo power plant operation. Apply by letter. Georgia. V–2273.

**Engineer** to organize and take charge of district promotional and educational work on use of lime in building, agriculture and chemistry. Work will be field work. Must have business experience in organization, sales and executive capacities, initia-

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tive, adaptability, common sense, perseverance, good address and ability to co-operate. Application by letter. District headquarters, Washington, D. C. V-2278.

**Metallurgist** experienced in automobile manufacture, capable of handling metallurgical department, including laboratory work, testing, etc. Apply by letter. Ohio. V-2310.

**Mechanical Engineer.**—30 to 35 years old, to go to South America and study out mechanical problems with metallurgical engineer, in connection with proposed nitrate plant. Will then return to states and supervise design of plant including refrigeration. Out of country six months to a year. Apply by letter. V-2370.

**Instructor** in mining engineering. Subjects ore dressing and coal washing, mine surveying, mine ventilation, electrical applications in mining and possibly mine design. Illinois. V-2378.

**Chemist.**—Lead, tin, antimony and copper analysis work. Young man to make analyses and supervise metallurgical plant. Good opening for recent graduate. New Jersey. V-2397.

**Junior Mining Engineers,** or men of broader experience. Apply by letter. Nevada. V-2452.

**Sales Executive** for established firm of engineers and constructors in New York. Man of character and standing, with wide acquaintance among business men and a talent and personality for sales. Apply by letter giving full information. V-2510.

**Sales Engineer** to sell crushing and grinding machinery. Apply in person. Commission basis. New York City V-2522.

**Superintendent** of mineral grinding plant grinding barytes, feldspars, etc. Age 35 to 40. General experience and some in this line. Apply by letter. Eastern United States. V-2540.

**Chemical Engineer** who has actual experience in production of flowers of sulfur from the crude. Contemplate erecting a plant for refining of sulfur. Wish to secure some information regarding cost of construction of plant and approximate cost of operation. Apply by letter. California. V-2545.

**Mining Engineer** for sales engineer experience in cyanide mill work. Apply by letter. New York City. V-2552.

**Recent Graduate—Mining Engineer** for work in gold mine in South America. Apply by letter stating age, education and experiences. V-2564.

**Sales Engineer** for chemical machinery. Some knowledge of chemistry required. 25 to 30 years of age with some experience. Apply by letter. Salary moderate at start. New York City. V-2574.

**Mining Engineer** familiar with mining of silica in all branches; to check report on property, purchase, install and operate equipment, etc. Connecticut. V-2590.

**Coal Mining Engineer.**—Between 35 and 45 years of age with some technical education and a number of years practical experience in actual operation of surface and underground mechanical equipment in mines of anthracite fields. Apply by letter, giving age, education, experience and salary desired. New York City.

**Mine Blacksmith** at feldspar quarry to sharpen Jackhamer steel. Apply by letter. Conn. V-2662.

**Contractors,** or qualified engineers to go into cost of construction of tunnel underneath river 650 ft. wide, together with cost of approaches, etc. Apply by letter. North Carolina. V-2693.

**Chemist** familiar with steel analysis to handle routine work in connection with plant in a new laboratory. Principally routine analysis of steel on raw stock coming in and other steel in process. Steels comprise high-grade steels for automobile construction, also tool steels. Some work on non-ferrous alloys, paints, gasoline and oil, and rubber. Apply by letter, giving full particulars. Pennsylvania. V-2695.

**Instructor in Ore Dressing and Metallurgy.**—Prefer man in early thirties with good balance of technical training and professional experience. Previous teaching experience unnecessary. Apply by letter. Idaho. V-2704.

**Two Practical Jig Operators.**—Single men preferred. Apply by letter. Illinois. V-2696.

**Sales Engineer.**—Technical graduate. Two to one years out of college. Some sales experience, preferably. Knowledge of gray iron casting business an advantage. Apply by letter. New York State. V-2697.

**Instructor in Ore Dressing and Metallurgy.**—Prefer man in early thirties with good balance of technical training and professional experience. Previous teaching experience unnecessary if personality is good. If satisfactory first year appointment permanent with usual promotion opportunities. Apply by letter. Idaho. V-2704.

**Engineer.**—Young man to take charge of cupola mixtures. Some foundry practice, as well as experience in mixing various grades of iron. Apply by letter. Rhode Island. V-2712.

**Engineer-draftsman** capable of plotting surveys, etc., from field notes and doing miscellaneous engineering work under direction. Single man. Expect employees to remain in Venezuela for period of 18 months, at end of which time they are entitled to fifty days leave, expenses coming to this country and returning to Venezuela being borne by company. Apply by letter. Venezuela; headquarters, Philadelphia, Pa. V-2725.

**Executive Secretary** for large engineering society in the East. Technically trained man at least 35 with experience in secretarial management, practical handling of club, technical publication and general clubhouse management. Tact, initiative and ability to meet men of affairs essential. Apply by letter stating experience in detail and accustomed compensation. V-2737.

**Mechanical Draftsman** with mine and mill experience. Apply by letter. Arizona. V-2790.

**Mine Manager** with diatomaceous earth experience. Apply by letter, stating age, education and experience. West. V-2808.

**Research Chemist** to make adjustment in oil sales. Apply by letter. New York State. V-2827.

**Mining Engineer** for Costa Rica. Must speak Spanish. Apply by letter, stating age, education and experience. V-2830.

**Assistant Professor** with coal washing and ore dressing experience. Must also have teaching experience. Apply by letter. Illinois. V-2843.

**Graduate Mining Engineer** with bituminous coal mining experience for research and investigation. Under 45 years of age, with 5 to 10 years coal mining experience. Apply by letter. Pennsylvania. V-2852.

**Junior Mining Engineer** with about four years coal-mining experience for research and investigation. Not over 30 years of age. Apply by letter. Pennsylvania. V-2863.

**Mining Engineer** with advertising experience to write up sales and advertising letters. Apply by letter. Temporary. New York City. V-2865.

**Engineer** to supervise operation of a hot tinning plant of medium size. Thoroughly familiar with pickling and tinning both hollow-ware and sheets. At least 10 years experience. Apply by letter. New Jersey. V-2877.

**Engineer.**—Some experience in foundry practice and development of patterns and also be good draftsman. Apply by letter. New York State. V-2920.

**Metallurgist** with 2 to 3 years experience in steel testing preferred. Apply by letter, stating age, education and experience. New York City. V-2951.

**Engineer** experienced in opening up coal mines. Apply by letter. South America. V-2960.

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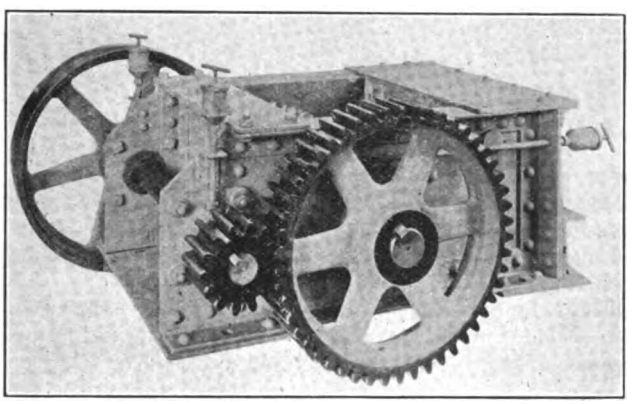
# Industrial News and Developments

Devoted to manufacturing and trade news of interest and value to the mining and metallurgical industry and invited from manufacturers and dealers. Scrutinized but not vouched for by the Institute.

## Armorframe Coal Crusher

THE latest development in single roll crushers is the Armorframe, manufactured by the Pennsylvania Crusher Co. of Philadelphia. A frame fabricated from slab steel plates into an unbreakable unit is substituted for the cast-iron frames used in the past. In the 18 by 18-in. and the 18 by 24-in. sizes, in which this design is now available, the steel side plates are 1 in. thick



and are connected by nine steel cross members heavily hot riveted into the rigid box frame.

The crusher proportions are unusually liberal throughout, and the design insures a continuous supply of uniformly crushed coal by affording the three safeguards—unbreakable steel frame, steel shear pin safety device and powerful relief springs—as protection against the heavy tramp iron which often has proved destructive to crushing machinery.

## Small Vertical Air Compressors

IMPROVED small vertical belt-driven air compressors known as Type Fifteen have been put on the market by the Ingersoll-Rand Co., 11 Broadway, New York. In addition to the plain belt drive design, each size is built as a self-contained electric motor outfit, driven through pinion and internal gears or by employing the short belt drive arrangement. The compressing end and electric motor of both gear and short belt drive units are furnished mounted on a common sub-base, so that they are in no way dependent upon the foundation for correct alignment.

Several noteworthy features of construction have been incorporated, of which the "constant-level" lubrication system is the most important. Others include the constant speed unloader for plain belt drive machines; the centrifugal unloader for start and stop control machines; and the increased size of the water reservoir cooling pot.

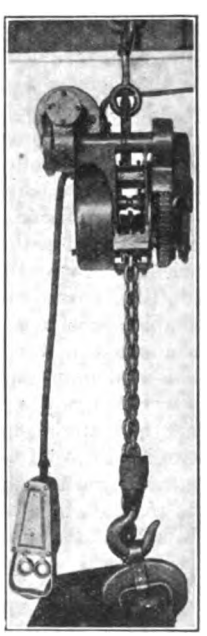
The "constant-level" system automatically maintains a constant level of oil, which insures the right amount being distributed to all parts.

The constant speed unloader controls the unloading of the compressor by automatically opening the inlet valve when the receiver pressure rises above that at which the unloader is set to operate. When the receiver pressure has fallen a predetermined amount, the unloader automatically releases the inlet valve and allows the compressor to return to work and thus build up the receiver pressure again.

The centrifugal unloader allows the compressor to start under "no load" such as is essential when automatic start and stop control is used, and permits the electric driving motor to come up to full speed before the load is thrown on automatically. This unloader accomplishes its purpose by holding the inlet valve open until the motor has reached full speed.

## Motor-driven Chain Hoist

AN ELECTRICALLY operated material-handling device, the Motorbloc, has been placed on the market by the Motorbloc Corpn. of Summerdale, Philadelphia, Pa. This device, conceived in the course of broad experience in the manufacture and marketing of the heavier and conventional forms of hoisting machinery, has been developed to serve the operations lying between the well-defined field of the standard hand chain hoist and that of the traveling electric hoist.



The Motorbloc consists of a standardized steel chain hoist electrified by a specially designed heavy-duty motor, reduction gearing and slip friction clutch, applied by means of a malleable iron supporting bracket comprising a self-contained electrifying unit, to which the pendant controller is also attached. In this way a simple, rugged mechanism has been developed for the electrification of the standard spur-geared chain hoist in capacities ranging from ¼ to 10 tons.

The self-contained, pendant controller is easily operated by the fingers of one hand, leaving the other hand free to guide the load. This arrangement makes it possible for one man, without physical effort, to accomplish what would otherwise require two or more men for lifting and placing the same load. The one-ton size complete weighs only 148 pounds.

While regularly furnished as a complete hoisting device, the self-contained electrifying unit can be applied to standard chain hoists already in service.

## Chemical Engineering Catalog

THE seventh annual edition of the Chemical Engineering Catalog has been issued. It is the official standard work of reference for chemical engineers, works managers, purchasing

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agents, operating engineers, and others who buy and specify equipment and materials to the various industries using chemical processes of manufacture. Although published by a commercial concern, the supervision of the compilation and formulation of the specifications and standards of this catalog are in the hands of a committee appointed by the American Institute of Chemical Engineers, the American Chemical Society, and the Society of Chemical Industry.

Although the function of the catalog is distinct from that of advertising, nevertheless it is considered an advertising medium. However, there is a constant growth in the amount of data presented on equipments not specifically chemical but nevertheless essential in the chemical industry, *e.g.*, power-plant equipment, material-handling equipment, melting, packing, lubricants, building materials, etc.

The volume contains 1185 pages of standard size, 9 by 12, printed on thin paper, and bound in a flexible cover. It is a prepossessing looking volume and indispensable for those for whom it is intended. It contains more than 200 pages of a classified index of products with the names of the manufacturers and a bibliography of nearly 100 pages of technical and scientific books with brief reviews of each. It is published by the Chemical Catalog Co., 19 East 24th St., New York City.

## War Department Surplus Property

THE United States Department of War is energetically disposing of its surplus stock at prices which ought to be attractive to any consumers of such material as remains on hand. Equipment and supplies of almost every branch of the service are represented in these sales, the Quartermaster material naturally predominating. These include clothing and camp equipage, office supplies, cooking utensils, tools, motor vehicles and parts, small vessels and launches and a considerable assortment of barrack buildings fully equipped for occupancy. Several plants suitable for manufacturing purposes are still available. These can be purchased with their real estate. The Ordnance Department is offering smokeless powder in bulk, machine tools and an assortment of stock metal. The Air Service is disposing of a wide variety of standard motors of well known types and their parts, together with a long list of photographic and other scientific apparatus. The Engineering Corp advertises locomotives, cars, cranes and pile drivers and an assortment of simple surveying and drafting instruments. The sales are conducted in three ways: By auctions at various places, sealed bids and informal bids and fixed prices. All sales are widely advertised in the newspapers and complete catalogues describing the materials under each group are obtainable, usually about two weeks in advance of the advertised sale. Any prospective purchaser will be placed on the War Department's mailing list on request addressed to the Office of the Director of Sales, 2515 Munitions Building, Washington, D. C.

## Asbestos Filter Cloth

THE Asbestos, Spinning & Weaving Corporation, New York City, is developing a considerable variety of fabrics applicable to different problems in filtration. The essential features of most of these fabrics is the weaving of asbestos or other fibres, whether of animal or vegetable origin, with wires of metals that withstand corrosion.

In addition to asbestos of which several grades have been utilized the fabrics which prove serviceable are cotton, wool, ramie, hemp and jute; the metals employed have been iron, dross, monel, nickel and lead coated steel. Obviously the combination most suitable for a given purpose will depend on the chemical nature of the solution to be filtered, the fineness of the solid and the working temperature.

The asbestos-monel combination has proved satisfactory for several cases. As compared with an all-asbestos cloth, this combination has the advantage of greater strength and less cost since, owing to the particular method of weaving it is not necessary to supply exclusively the larger and more expensive grades of asbestos. The ramie cloth has been found applicable to pneumatic flotation machines having the advantage over cotton, that it is stronger and not susceptible to mildew.

The same concern is engaging in the manufacture of all-mineral brake lining, having no rubber in its composition.

## Industrial Notes

**The American Mines Door Co.,** Canton, Ohio, has appointed J. O. Durkee Sales Representative at Pittsburgh, Pa. After some years as an operating mine official Mr. Durkee was Editor of *Coal Industry* and recently has been with The Keystone Publishing Company.

**Wilson Welding & Metal Co.,** 132 King St., New York City, is represented in Maryland, Virginia and District of Columbia by the Alexander Milburn Co. of Baltimore, where a complete demonstration plant is in operation.

## Trade Catalogs

**W. S. Rockwell Co.,** 50 Church St., New York.—Booklet 250, Elements of Industrial Heating (44 pages). This booklet,which has been prepared in an attempt to develop a better understanding of the principles governing industrial heating operations that are generally neglected in practice, has been very well received and adopted as part of the text in a number of leading universities and trade schools.

**Electric Railway Equipment Co.,** 2900 Cormany Ave., Cincinnati, Ohio.—Catalog 22 (cloth bound, 214 pages), Direct Suspension Trolley Line Material and Brackets for Coal and Metal Mining Operation, also Urban, Interurban and Industrial Railways.

**Traylor Engineering & Mfg. Co.,** Allentown, Pa.—Bulletin 99, Bulldog Jaw Crushers. Bulletin 100, Bulldog Gyratory Crushers. Bulletin 101, the Superpump and Hydraulic Machinery. Bulletin 103, Ball, Tube, Rod and Combination Mills.

**Combustion Engineering Corporation,** 43 Broad St., New York, N. Y.—Bulletin CB1, The Coxe Stoker, for all low-grade fuels. Booklet, Service from the Standpoint of the Stoker Manufacturer, by John Van Brunt.

**Brown Hoisting Machinery Co.,** Cleveland, Ohio.—Booklet 5-22, Serving the Mining Industry. On Brownhoist cranes, conveyors, coal crushers, larries, electric hoists, grab buckets, and bins.

**Dayton-Dowd Co.,** Quincy, Ill.—Bulletin 249, superseding Bulletin 244, on Centrifugal Pumps.

**Ingersoll-Rand Co.,** 11 Broadway, New York, N. Y.—Leaflets on Portable Air Compressors.

**Bemis Bro. Bag Co.,** Cupples Station, St. Louis, Mo.—Booklet on Better Ventilation, by means of Flexipipe, a flexible canvas tubing.

**Morse Chain Co.,** Ithaca, N. Y.—Publication No. 24, A Chain of Evidence, on Morse silent chains.

**American Mine Door Co.,** Canton, Ohio.—Leaflet on the Canton Automatic Mine Switch Thrower.

**Stearns Conveyor Co.,** Cleveland, Ohio.—Leaflet on Belt Conveyor Carriers.

**Koehring Co.,** Milwaukee, Wis.—Leaflet on Heavy Duty Crane Excavator.

**De La Vergne Machine Co.,** E. 138th St., New York, N. Y.—Bulletin 181, on Vertical Diesel Engine Type SI.

**Aldrich Pump Co.,** Allentown, Pa.—Leaflet on Aldrich Pumps.

**Marchant Calculating Machine Co.,** Oakland, Cal.—Leaflet on the New Keyboard Calculator.

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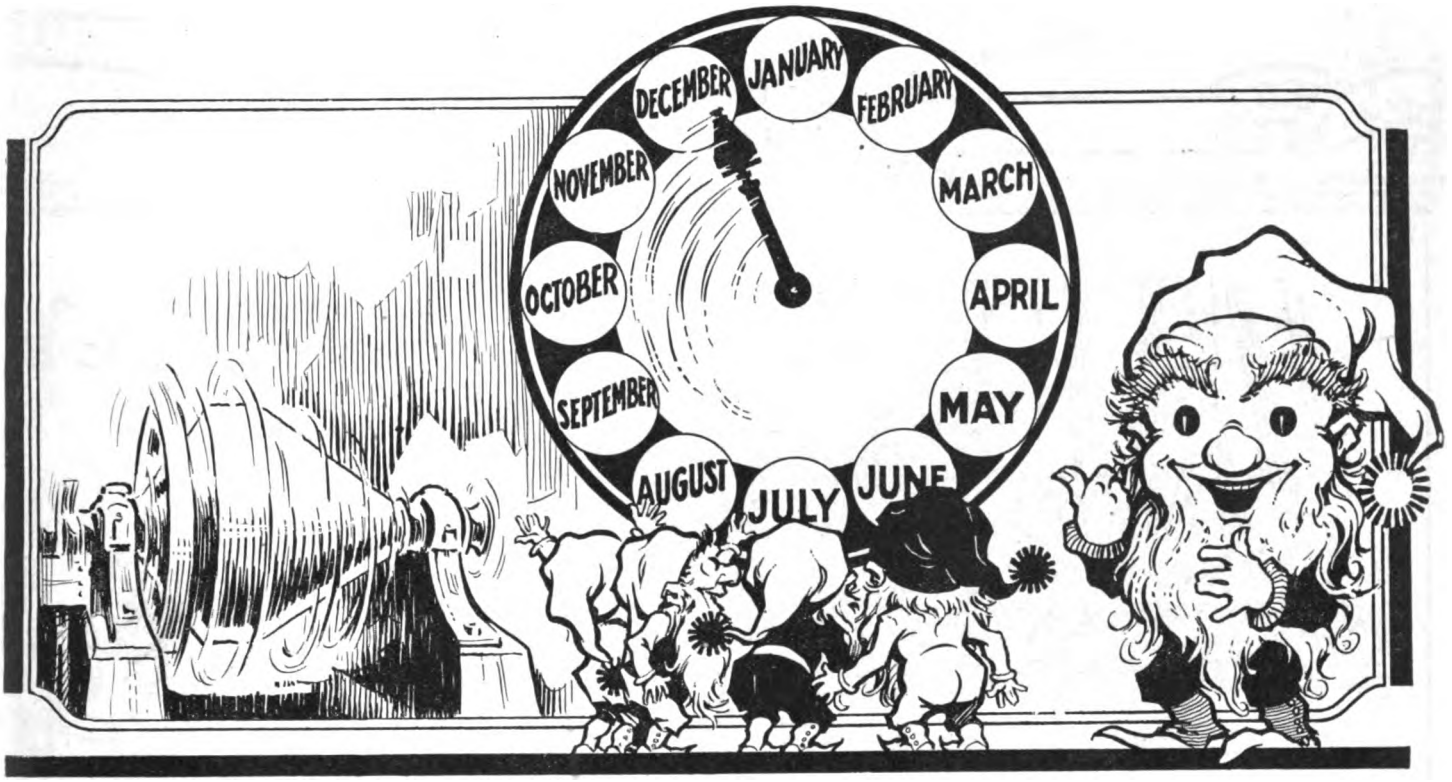


# 8928-Hours of Continuous Grinding —Without a Moment's Shutdown

Just think—One of the Hardinge Mills at Nevada Con. ran for over a year without stopping for any cause whatsoever.

Did you ever figure what it costs to shut a mill down even for an hour? Figure it out for yourself and you will be surprised. Example:

> If your mill is grinding an $8.00 gold ore at the rate of 10 tons per hour, and is shut down for an hour, $80.00 are lost beyond recovery.

The Hardinge Mill is simple. It is due to this simplicity that it keeps running right along, day in and day out, for months at a time so smoothly that once installed it is all but forgotten and figures covering the cost of shutdowns are too small to bother with.

**HARDINGE COMPANY**

WORKS YORK, PENNA. DENVER, COLO. & RITH, ENG.

120 BROADWAY, NEW YORK, N.Y.

BRANCH OFFICES
SALT LAKE CITY, UTAH; NEWHOUSE BUILDING
LONDON, ENGLAND; 11 SOUTHAMPTON ROW

CABLE ADDRESS "HARDINGMIL NEW YORK"

# Hardinge Conical Mills

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**WAR DEPARTMENT**

Dec. 13—ORDNANCE MATERIALS — Morgan Depot, South Amboy, N. J., Auction. For catalog write Phila. Dist. Ord. Salvage Board, Frankford Arsenal, Philadelphia, Pa.

Dec. 15—Q. M. SUPPLIES —Philadelphia, Pa., Auction. For catalog write Q. M. S. O., Ist. Ave. & 59th St., Brooklyn, N. Y.

Dec. 19—ORDNANCE MATERIALS — Middletown, Pa., Auction. For catalog write Phila. Dist. Ord. Salvage Board, Frankford Arsenal, Phila., Pa.

Dec. 20—FLOATING EQUIPMENT — San Francisco, Calif., Sealed Bids. For catalog write Western Surplus Property Control Officer, Ft. Mason, San Francisco, Calif.

The Government reserves the right to reject any or all bids.

**SELLING PROGRAM**

In deference to the Christmas holiday "rush," which imposes a peak load on virtually all business, the War Department has scheduled no sales of surplus materials between December 20 and the new year.

Beginning early in 1923, however, there will be instituted a series of auction and sealed bid sales of tremendous importance to buyers in both the merchandise and and industrial fields. These sales will present quantities of the same substantial commodities that featured War Department offerings during 1922.

The booklet illustrated herewith, "War Surplus," gives a splendid idea of the wide range of materials to be sold in the new year. Time passed in perusing your copy of the booklet will be time most profitably spent.

**SEND FOR CATALOG** **SEND FOR CATALOG**

WAR DEP


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# No Profit in Marking Time

Idle machines do more than gather dust. They pile up a costly overhead—while you're waiting for the material that wasn't delivered on schedule.

Many a plant has been saved this embarrassment and expense by discovering a War Department Sale on just the materials they needed. For every War Department Sale means *immediate delivery!*

And a big saving as well.

Look in your business paper or the daily press for the Sales announcements. When you find one that fits your needs, send for the catalog. Then seize your opportunity, for it will never come again. Address inquiries to Major J. L. Frink, Chief, Sales Promotion Section, Office, Director of Sales, Room 2515, Munitions Building, Washington, D. C.

*Send for this booklet,*
*The Story of War Department Sales.*

ARTMENT

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# Consider the Conditions—

Mining camps are usually located far away in inaccessible mountain ranges, to which the transportation of engineering supplies is long, difficult, and often through the tropics. This means time and changing climatic conditions, which have a most serious effect upon the life of the average rod packing.

For this reason packings that contain rubber, or are not properly lubricated, cannot possibly give a uniform length of service, as they deteriorate with age and the tropical heat.

TRADE MARK

# "PALMETTO"

REG. U.S PAT. OFFICE

is an ideal packing for mining operations, because it does not contain rubber or any other substance that age or heat can effect. It has a thoroughness of lubrication unknown to other packings — therefore "Palmetto" is always the same uniformly high quality, no matter what the conditions.

**For high pressures, superheated steam and compressed air pressures "Palmetto" has no equal for satisfactory service.**

***We can prove this if you will let us send you free working samples of both braided and twist, to test under your own conditions. State size desired.***

## GREENE, TWEED & CO.

*Sole Manufacturers*

**109 Duane St., New York**

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# *Return this coupon for a free sample of this new ESSCO Type Clamp.*

Total height of Assembly is only 2 inches

We want to show you the ultimate in a trolley wire clamp. When you examine it we think you will want to standardize on this new ESSCO Type Keystone Clamp for your haulageways.

It is only two inches high. It has only four parts. It offers the least possible obstruction to the trolley wheel and it *everlastingly grips the trolley wire.*

It's more than "just a real good piece of hardware"; it's "a real good clamp." Send for it and see. It will cost you nothing but a two-cent stamp.

***This coupon is your admission ticket to low headroom—***

**Fill it out and send it today. Upon its receipt we will immediately send you a real life-size ESSCO Type Keystone Clamp free together with all the data describing it.**

**Keystone Trolley Wire Clamp**

ELECTRIC SERVICE SUPPLIES CO.,
17th and Cambria Sts., Philadelphia, Pa.

Gentlemen:—Your new ESSCO Type of Keystone Clamp looks good to me, I want to look it over. I accept your offer. Kindly send a sample clamp and all the data to me at once.

Name and Title.....

Name of Company.....

City and State.....

M. & M.

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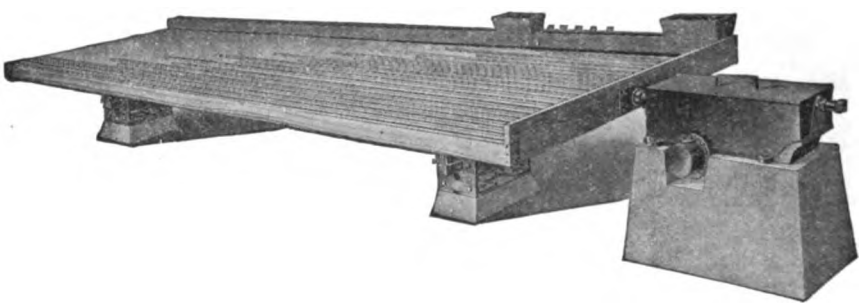
# Wilfley Concentrating Tables

**The Nevada Consolidated Copper Company again buys *WILFLEYS*—200 this time.**



No. 11-D

The latest model of the wonderful *WILFLEY*—the last word in concentrating tables

## The History of the *WILFLEY* is the History of Concentration

TWENTY-THREE years ago—in 1899—D. C. Jackling equipped an experimental mill at Bingham with five stamps and two *WILFLEY TABLES.*

THAT experiment proved to be one of the foundation-stones for the remarkable success of the Utah Copper Company.

DURING the intervening years changes, betterments, refinements have been wrought in the *WILFLEY.* But the basic principle is the same—the principle which continues to impel Mr. Jackling, and other discriminating operators throughout the world, to select the *WILFLEY.*

THE *WILFLEY* effects concentration by means of a light, rigid deck moving in a horizontal line. And the deck is connected to a head-motion which imparts the maximum of travel to the mineral upon the deck with the minimum of external agitation—in conection with *properly adjusted* straightline riffles which eliminate the gangue all along the table.

*An interesting brochure on ore concentrating will be mailed on request*

The Mine and Smelter Supply Company

DENVER SALT LAKE CITY EL PASO

NEW YORK CITY
42 Broadway

SAN FRANCISCO
Mills Building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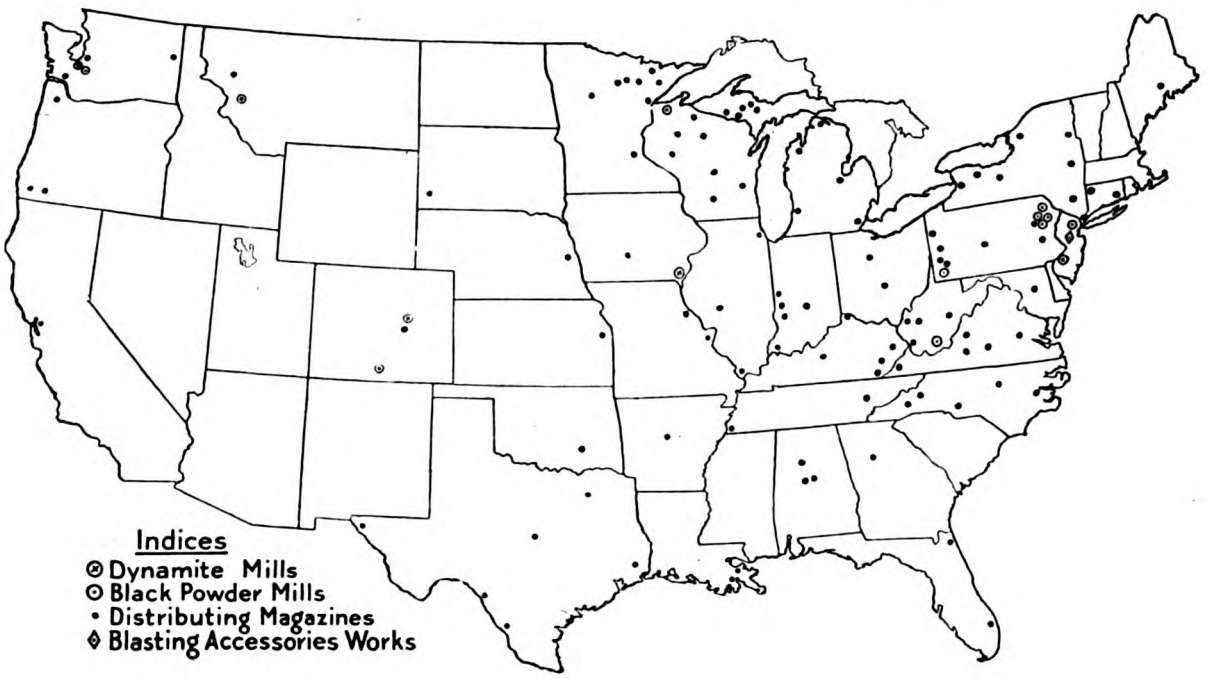


# One Day's Interruption in Your Working Plans Cost—?

HUNDREDS and thousands—and hundreds of thousands of dollars can be lost by the failure of explosives to arrive on time.

But with du Pont Service extending to every section of the country—no mine, no quarry, no engineering project need for one moment be held up through delay in receiving explosives.

Located at strategic points from coast to coast are twenty-four du Pont dynamite and black powder mills constantly supplying blasting materials to magazines—the distributing points from which explosives may be procured within the briefest possible time.

Such efficient distribution eliminates storage and transportation costs. Du Pont magazines are your storage plants until such time as you need explosives.

With the reputation of leadership in the Explosives field, based on 120 years of experience, du Pont is still furthering Industry's progress by anticipating her future needs. But today's needs are to be met—and du Pont can and is meeting them.

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Atlantic City, N. J.

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***Explosives Department***
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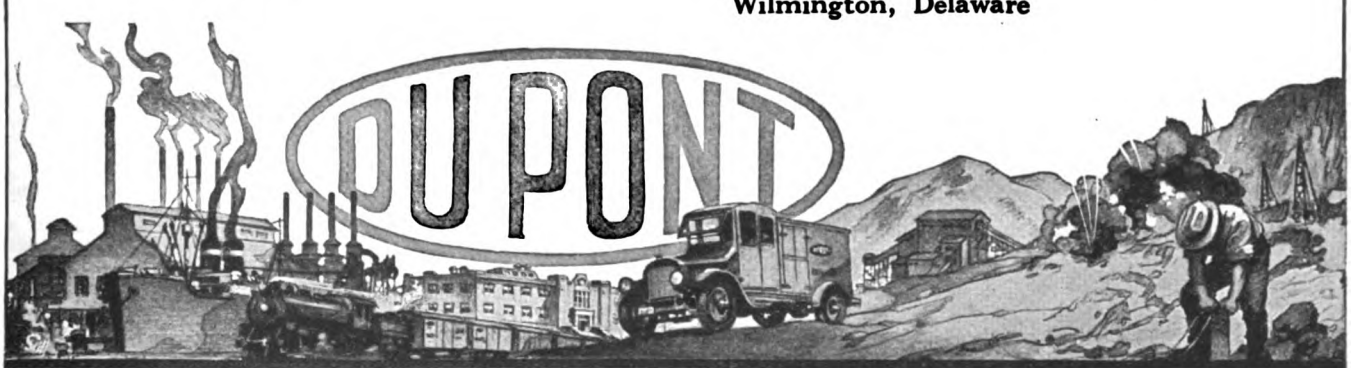


**EXPLOSIVES ~ SERVICE**

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# The Mining and Metallurgical Index

## of 1300 Domestic and Foreign Periodicals Received Before Nov. 1, 1922

Volume numbers are in heavy-faced figures, page numbers in light-faced figures. Approximate number of words is stated.


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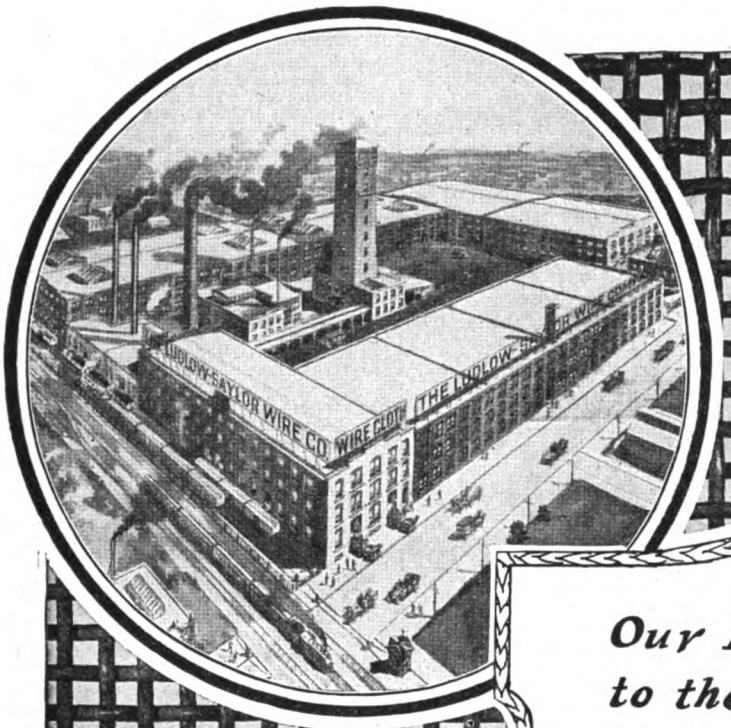


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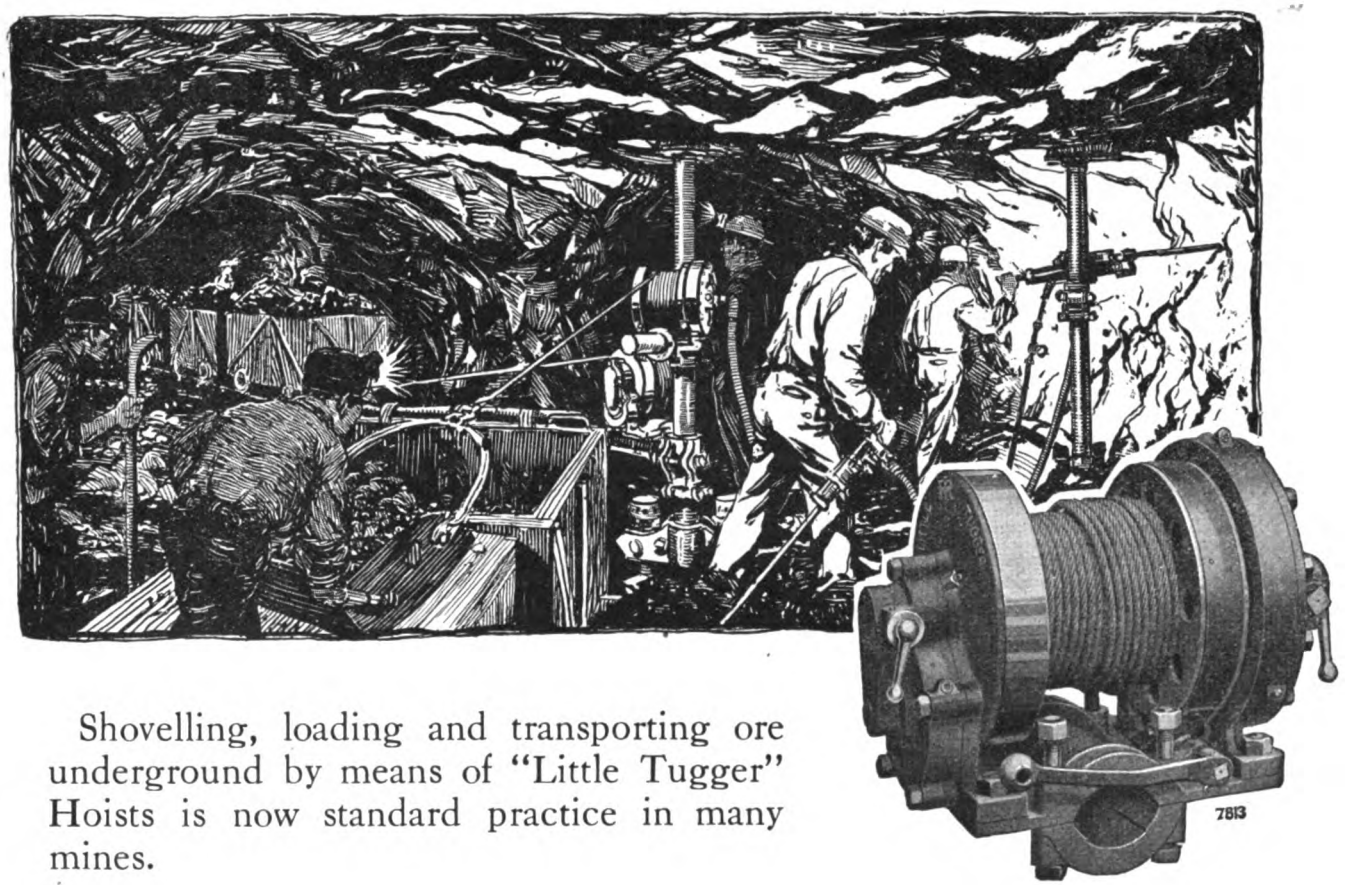


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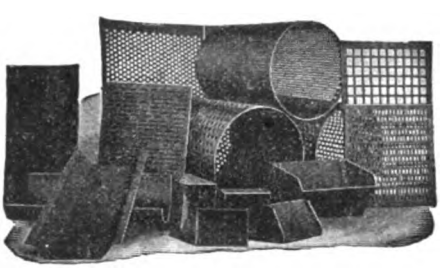

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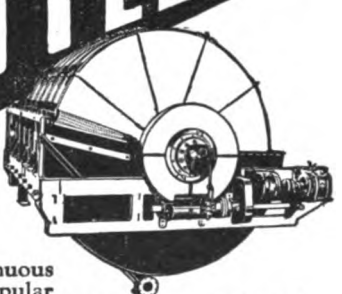

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ARC FURNACES, New regulating device for electric. Eine neue Regeleinrichtung für elektrische Lichtbogenöfen. E. F. Russ, *Giesserei-Ztg.* (Oct. 3, 1922) **19**, 575–7. 1200 w.

CARBON ELECTRODES and their manufacture for the production of electric cast steel. Die Kohlenelektroden und ihre Herstellung für die Erzeugung von Elektrostahlguss. F. Russ, *Giesserei-Ztg.* (Aug. 29, 1922) **19**, 493–7. 2200 w.

CASTING MACHINES. L. Cammen, Brit. Pat. 184472. *Ill. Off. Jnl.* (Oct. 4, 1922) **4304**. 60 w. Electrically heated molds.

ELECTRIC BLAST FURNACE, Method of and means for reducing ores in. E. Fornander, U. S. Pat. 1430971. *Off. Gas.* (Oct. 3, 1922) **303**, 94. 140 w.

ELECTRIC FORGING and heat treating furnace. F. G. Dawson, U. S. Pat. 1430438. *Off. Gaz.* (Sept. 26, 1922) **302**, 706. 55 w.

ELECTRICAL FURNACE for treating ores. A. Counas, U. S. Pat. 1430948. *Off. Gas.* (Oct. 3, 1922) **303**, 90. 50 w.

ELECTRIC HEAT, its generation, progation, and application in industrial processes. E. F. Collins, Am. Electrochem. Soc. *Advance Copy* (Sept. 25, 1922) 233–60.

ELECTRIC HEATING by ironless induction. E. F. Northrup, *Gen. Elect. Rev.* (Nov., 1922) **25**, 656–66.

ELECTRIC MELTING of metals, Economic importance. Die wirtschaftliche Bedeutung des elektrischen Schmelzens von Metallen. E. Fr. Russ, *Giesserei-Ztg.* (Sept. 19, 1922) **19**, 544–8. 2500 w. Serial. (Sept. 26, 1922) **19**, 559–62. 2200 w.

ELECTRIC STEEL CASTINGS, Making. *Fdy. Tr. Jnl.* (Oct. 12, 1922) **26**, 305–6. 1500 w.

ELECTRIC STEEL FURNACES, new, at the Fiat works in Turin. Die neuen Elektrostahlöfen der Fiat-Werke in Turin. G. Vitali, *Elektrotech. Ztsch.* (Sept. 21, 1922) **43**, 1177–9. 1500 w.

FERROCHROMIUM alloys, Manufacture. W. B. Ballantine, U. S. Pat. 1430878. *Off. Gas.* (Oct. 3, 1922) **303**, 75. 40 w. Fuse ferrochrome mixture in electric furnace and oxidise impurities.

HEROULT FURNACE and its operation. Der Heroult-Ofen und sein Schmelsbetrieb. K. Kerpely, *Giesserei-Ztg.* (Aug. 29, 1922) **19**, 487–91. 3500 w.

HIGH SPEED TOOL STEEL, Treating. H. K. Ogilvie, *Iron Tr. Rev.* (Oct. 26, 1922) **71**, 1128–33. 4500 w. Before Iron and Steel Inst.

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ACID RESISTING metals and alloys. G. A. Drysdale, *Coal Ind.* (Oct., 1922) **5**, 452–4. 2500 w. Research on non-ferrous metals and alloys.

ALLOY. A. H. Coplan, U. S. Pat. 1433180. *Off. Gas.* (Oct. 24, 1922) **303**, 717. 35 w. Chromium, nickel, manganese, carbon, etc.

ALLOY. F. Milliken, U. S. Pat. 1432607. *Off. Gas.* (Oct. 17, 1922) **303**, 542. 30 w. Copper, nickel, zinc, iron.

ALLOY. J. O. Whiteley, U. S. Pat. 1431713. *Off. Gaz.* (Oct. 10, 1922) **303**, 297. 15 w. Gold and platinum.

ALLOY. Metallic alloy for repair purposes. P. O. Melton, U. S. Pat. 1429959. *Off. Gaz.* (Sept. 26, 1922) **302**, 609. 20 w. Zinc, lead, tin, copper.

ALLOYS, Composition white metal. C. E. Hansen, U. S. Pat. 1431113. *Off. Gaz.* (Oct. 3, 1922) **303**, 123. 18 w. Copper, nickel, zinc, tin, and cobalt.

ALLOYS. Mitsubishi Zosen Kabushiki, Kaisha. Brit. Pat. 183809. *Ill. Off. Jnl.* (Sept. 20, 1922) 4022. 70 w. Copper aluminum-nickel-iron alloy for turbine blades.

ALPAX—a new aluminum alloy. M. deFleury, *Fdy. Tr. Jnl.* (Oct. 12, 1922) **26**, 304. 800 w.

ALUMINUM and magnesium in engine and automobile construction. Aluminum und Magnesium im Motoren und Automobilbau. W. V. Selve, *Tech. Blätter* (May 13, 1922) **12**, 193. 1000 w.

ALUMINIUM ALLOY pistons. F. A. Livermore, *Fdy. Tr. Jnl.* (Sept. 21, 1922) **26**, 248. 1000 w.

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ALUMINUM ALLOYS for casting. *Chem. & Met. Engng.* (Sept. 6, 1922) **27**, 501–3. 3000 w.

ALUMINUM ALLOYS, Usefulness of molybdenum in purifying. Die Verwendbarkeit des Molybdäns zur Veredelung von Aluminiumlegierungen. H. Riemann, *Ztsch. Metallkunde* (May, 1922) **14**, 195–203. 4500 w.

BABBITT BEARINGS, Overcoming difficulties. W. S. Standiford, *Canad. Machy.* (Oct. 19, 1922) **28**, 26–7. 2000 w.

BABBITT METAL. L. D. Allen, *Machy.* N. Y. (Oct., 1922) **29**, 114–5. 1500 w.

BABBITT METAL, Selection and use. L. D. Allen, *Machy.* N. Y. (Nov., 1922) **29**, 211–3. 2000 w.

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BINARY ALLOYS, On the relation between the equilibrium diagram and the hardness. T. Isihara, *Sci. Repts.* Tohoku Imp. Univ. (June, 1922) **11**, 207–22.

BRITTLENESS and fatigue in metals. C. H. Desch, *Machy. Market* (Oct. 13, 1922) 29–30. 3000 w. Serial.

COPPER and copper alloys in the chemical and allied industries. W. *Stark, Chem. Age.* I. (Oct., 1922) **30**, 457–9. 2000 w. Serial.

COPPER SUBSTITUTES. Zur Frage des Ersatzes der Kupfers durch andere Metalle. E. H. Schulze, *Ztsch. Metallkunde* (Aug., 1922) **14**, 321–8. 5500 w.

COPPER. Water in blister copper bars and pigs. A. R. Ledoux, *Min. & Met.* (Oct., 1922) 7-9. 1200 w.

DENSITY measurements of metals and alloys at high temperature, especially in liquid condition. Dichtemessungen von Metallen und Legierungen bei hohen Temperaturen mit besonderer Berücksichtigung des flüssigen Zustandes. K. Bornemann and P. Siebe and M. Wehle, *Ztsch. Metallkunde.* III. (Aug., 1922) **14**, 329–34. 3500 w.

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DURALUMIN, A digest of information. H. C. Knerr, *Trans.* Am. Soc. for Steel Treat. (Oct., 1922) **2**, 13–42.

ELASTICITY of some metals and alloys at temperatures up to their melting points. Die Elastisität einiger Metalle und Legierungen bis zu Temperaturen, die ihrem Schmelspunkt naheliegen. K. R. Koch and R. Dieterle, *Ann. Physik* (Nov. 13, 1922) **68**, 441–62.

EXTRUSION, Manufacture of articles by. C. A. Parsons, A. Q. Carnegie, M. Bone, and S. S. Cook, U. S. Pat. 1430399. *Off. Gas.* (Sept. 26, 1922) **302**, 698. 75 w. Turbine blade. U. S. Pat. 1430400. 699. 30 w.

EUTECTICS, Structure. F. L. Brady, *Engng* (Oct. 13, 1922) **114**, 474–7. 4500 w. Serial. Before Inst. of Metals.

FATIGUE of metals. L. Bairstow, *Beama.* I. (Oct., 1922) **11**, 652–7. 4000 w. Serial.

FEEDER for ingot molds. B. H. Howard and E. J. Turner, U. S. Pat. 1431803. *Off. Gas.* (Oct. 10, 1922) **303**, 316. 12 w. Also U. S. Pat. 1431804. 35 w. U. S. Pat. 1431853. 325. 22 w.

HARDNESS. An accurate method of determining the hardness of metals with particular reference to those of a high degree of hardness. R. L. Smith and G. E. Sandland, *Proc.* Inst. Mech. Engrs. (May, 1922) **1**, 623–41.

GENELITE—a new bearing material. E. G. Gilson, *Machy.* N. Y. (Oct., 1922) **29**, 123–4. 1500 w.

INTERNAL STRESS. Effect determination and elimination of internal stresses in cold wrought brass and nickel silver. G. L. Thirkell, *Commonwealth Engr.* III. (Aug. 1, 1922) **10**, 18–22. 3000 w. Concluded.

MANGANESE BRONZE. F. A. Livermore, *Mech. Wld.* (Sept. 29, 1922) **72**, 218–9. 1500 w. From *Fdy. Tr. Jnl.*

MONEL METAL, Mill to roll. F. C. Watson, *Iron Age* (Oct. 19, 1922) **110**, 1011–2. 1200 w. Before Iron & Steel Elect. Engrs.

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SEGREGATION phenomena in metallic alloys. Seigerungserscheinungen in Metallegierungen. O. Bauer and H. Arndt, *Stahl u. Eisen* (Aug. 31, 1922) **42**, 1346–56.

STEAM. Effect of superheated steam on non-ferrous metals used in locomotives. H. Fowler, Inst. of Metals. *Advance Copy* (Sept., 1922) 4 pp. 1000 w. *Engng.* (Sept. 22, 1922) **114**, 374. 1000 w. Before Inst. of Metals.

TEMPERATURE. Effect of temperature, pressure, and structure on mechanical properties of metal. Z. Jeffries and R. S. Archer, *Chem. & Met. Engng.* (Oct. 11, 1922) **27**, 747–51. 4500 w.

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TIN containing aluminum, Brittleness of. Brüchigwerden von aluminiumhaltigem Zinn. E. Wetzel, *Ztsch. Metallkunde* (Aug., 1922) **14**, 335–6. 1200 w.

TITANIUM ALLOY. A. W. Clement, U. S. Pat. 1431725. *Off. Gas.* (Oct. 10, 1922) **303**, 300. 35 w. Titanium, chromium, iron and molybdenum.

TUNGSTEN. Process of reducing tungstic oxide to tungsten metal. W. F. Bleecker, U. S. Pat. 1427187. *Off. Gas.* (Aug. 29, 1922) **301**, 873. 40 w.

VANADIUM and its metallurgical uses. *Chem. Tr. Jnl.* (Aug. 25, 1922) **71**, 225–6. 3000 w. From *Engng.*

WHITE METAL ALLOYS, Analysis. E. W. Sheel, *Metal Ind.* London (Oct. 13, 1922) **21**, 337–9. 3000 w.

WHITE METALS. A. H. Mundey, C. C. Bissett and J. Cartland, with discussion. *Metal Ind.* London. I. (Sept. 29, 1922) **21**, 291–4. 3500 w. Serial. II. (Oct. 6, 1922) **21**, 316–22. 7500 w. *Iron & Coal Tr. Rev.* (Sept. 22, 1922) **105**, 2500 w. *Fdy. Tr. Jnl.* (Sept. 28, 1922) **26**, 265–6. 2500 w. *Machy. Market* (Oct. 13, 1922) 27–8. 2000 w. Before Inst. of Metals.

WIRE. Drawing. Naamloose Vennootschap Philips' Gloeilampenfabricken. Brit. Pat. 183807. *Ill. Off. Jnl.* (Sept. 20, 1922) 4021–2. 100 w. Tungsten wire drawn in tungsten cobalt alloy dies.

WIRE FORMING. *Machy.* London. II. (Sept. 21, 1922) **20**, 756–60. 3500 w.

### Pyro

ALUMINUM, Effects of over-heating and repeated melting. W. Rosenhain and J. D. Grogan, *Metal Ind.* London (Oct. 13, 1922) **21**, 343–6. 3000 w. Inst. of Metals *Advance Copy* (Sept., 1922) 11 pp. *Engng.* (Sept. 29, 1922) **114**, 414–5. 2500 w. Before Inst. of Metals.

ALUMINUM melting practice. R. J. Anderson, *Foundry.* I. (Sept. 15, 1922) **50**, 737–41. 5000 w. Serial. II. (Oct. 1, 1922) **50**, 792–6. 6000 w. III. (Oct. 15, 1922) **50**, 823–6. 4500 w.

ALUMINUM ALLOYS, Iron-pot melting practice. R. J. Anderson, *Metal Ind.* N. Y. (Sept., 1922) **20**, 342–4. 2500 w. Conclusion.

BRASS. Manufacturing brass from copper bands. R. N. Richardson, *Engng. Production* (Oct. 12, 1922) **5**, 356. 1000 w.

CASTING MACHINES, Casting and molding metals. E. Ericsson, Brit. Pat. 184802. *Ill. Off. Jnl.* (Oct. 11, 1922) 4432–3. 400 w.

CASE HARDENING, Metal heating furnaces. Coventry Chain Co., Ltd. and H. A. Ludgeon, Brit. Pat. 181888. *Ill. Off. Jnl.* (Aug. 16, 1922) 3266. 250 w.

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CHLORIDIZING VOLATILIZATION, Ore treatment. W. H. Dyson and L. Aitchison, N. Z. Pat. 46766. *N. Z. Pat. Off. Jnl.* (Sept. 7, 1922) **11**, 384–5. 500 w. Also N. Z. Pat. 46767. 350 w.

HEAT TREATING ROOM, Gas engine in. J. W. Smith, *Gas Age-Rec.* (Oct. 14, 1922) **50**, 447–82. 1500 w. Serial. (Oct. 21, 1922) **50**, 517–9. 1000 w.

LEAD, Heat treating in. R. B. Schenck, *Trans.* Am. Soc. for Steel Treat. (Sept., 1922) **2**, 1203–12.

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MELTING and pouring furnace. I. Kormuth, Canad. Pat. 224435. *Off. Rec.* (Oct. 3, 1922) **50**, 2808. 150 w.

ORE ROASTING, Retorts. J. P. B. Webster, Brit. Pat. 184040. *Ill. Off. Jnl.* (Sept. 27, 1922) 4123–4. 185 w.

ORE TREATING FURNACE. C. C. Grimes, U. S. Pat. 1430445. *Off. Gaz.* (Sept. 26, 1922) **302**, 708. 50 w.

POWDERED COAL in the lead blast furnace. E. H. Hamilton, *Min. & Met.* (Oct., 1922) 25–7. 1500 w.

PYRITIC SMELTING at the Siemens-Kwarschana copper works, in the Caucasus. C. Offerhaus, *Engng. & Min. Jnl.-Pr.* (Sept. 30, 1922) **114**, 589–96. 5000 w.

PYRITIC SMELTING, in a reverberatory, Proposed. E. C. King, *Engng. & Min. Jnl.-Pr.* (Oct. 7, 1922) **114**, 633–4. 1200 w.

REFRACTORIES for zinc smelting. G. C. Stone, *Jnl.* Am. Ceramic Soc. (Sept., 1922) **5**, 597–601. 1500 w.

SINTERING, Process of treating ores to sinter them. A. S. Dwight, U. S. Pat. 1433348.

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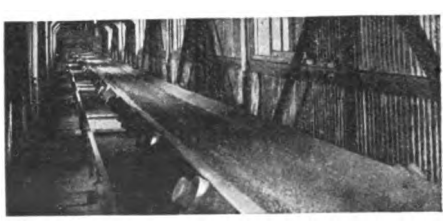

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*Off. Gas.* (Oct. 24, 1922) **303**, 750. 125 w. Also U. S. Pat. 1433349. 750–1. 70 w.; U. S. Pat. 1433350. 751. 55 w.; U. S. Pat. 1433351. 751. 70 w.; U. S. Pat. 1433352. 751. 50 w. U. S. Pat. 1433353. 751. 85 w.; U. S. Pat. 1433354. 751. 60 w.; U. S. Pat. 1433355. 752. 70 w.

SMELTER. Description of the reduction plant erected at the Transvaal Silver and Base Metals, Ltd. H. W. Clayden, with discussion. *Jnl.* So. Afr. Inst. of Engrs. (Sept., 1922) **21**, 20–7. 4500 w.

SMELTING FURNACE. Faconeisen-Walzwerk L. Mannstaedt et Cie Akt.-Ges. and H. Bansen, Brit. Pat. 184252. *Ill. Off. Jnl.* (Oct. 4, 1922) 4221–2. 250 w. Gaseous fuel.

TEMPERATURE REGULATOR. A new type of automatic temperature regulator and its application to heat treating furnaces. R. W. Newcomb, *Trans.* Am. Soc. for Steel Treat. (Oct., 1922) **3**, 98–102. 2500 w.

TUNGSTEN. Experimental attempts to decompose tungsten at high temperatures. G. I. Wendt and C. E. Irion, *Jnl.* Am. Chem. Soc. (Sept., 1922) **44**, 1887–94. 2500 w.

VANDADIUM, Process of recovering. W. E. Stokes, U. S. Pat. 1428616. *Off. Gas.* (Sept. 12, 1922) **302**, 226. 15 w. Heat the ore with an alkali metal nitrate.

WIRE DRAWING. Drawing and] rolling wire F. G. Brettell, Brit. Pat. 184379. *Ill. Off. Jnl.* (Oct. 4, 1922) 4271. 150 w.

ZINC, Metallurgical apparatus. A. Donaldson, U. S. Pat. 1432842. *Off. Gas.* (Oct. 24, 1922) **303**, 649. 25 w. Portable fume condenser for zinc furnaces.

## Hydro

CADMIUM, Treatment of zinc lead fume. W. G. Waring, U. S. Pat. 1430272. *Off. Gas.* (Sept. 26, 1922) **302**, 673. 50 w. Roast and leach out cadmium.

CHLORINATION, Ore treatment. Kalmus, Comstock & Westcott, Canad. Pat. 224039. *Off. Rec.* (Sept. 26, 1922) **50**, 2696. 150 w. Cobalt nickel silver ore.

COPPER and other metallic sulphates. H. Bardt, Brit. Pat. 184402. *Ill. Off. Jnl.* (Oct. 4, 1922) 4280. 250 w. Recovery of waste metal by electrolysis.

COPPER extraction process, Greenawalt electrolytic. W. E. Greenawalt, *Engng. & Min. Jnl.-Pr.* (Oct. 21, 1922) **114**, 7112–7. 5800 w.

COPPER. Process of and apparatus for precipitating copper from solutions. F. S. Adams, U. S. Pat. 1430140. *Off. Gas.* (Sept. 26, 1922) **302**, 646. 25 w. Sulphur dioxide is passed through the solution.

CYANIDE PROCESS of treating ores of the precious metals. D. L. H. Forbes, U. S. Pat. 1430635. *Off. Gas.* (Oct. 3, 1922) **303**, 26. 30 w. Inject dry sodium peroxide below surface of mixed ore and cyanide.

ELECTROLYSIS. E. L. Gaston, Brit. Pat. 181006. *Ill. Off. Jnl.* (Aug. 2, 1922) 2913. 475 w. Deposition of aluminum, etc., on mandrels to make tubular articles.

ELECTROLYSIS, Process for obtaining the copper from lyes resulting from the treatment of cupriferous pyrites. H. P. Soulée-Cottineau, U. S. Pat. 1431130. *Off. Gas.* (Oct. 3, 1922) **303**, 126. 50 w. Deposition on iron.

GOLD precipitation of zinc dust and in conjunction with the de-aeration of solution at Modderfontein "B." S. Newton and L. L. Fewster, *So. Afr. Min. Jnl.* (Sept., 1922) **33**, 173–5. 3500 w. Before Chem, Met. and Min. Soc. of So. Afr.

LEACHING with sulphur dioxide. C. E. van Barneveld and E. S. Leaver, *Min. Mag.* (Sept., 1922) **27**, 144–54. *Min. Jnl.* (Sept. 16, 1922) **138**, 714–5. 2500 w. Serial. (Sept. 30, 1922) **138**, 736–7. 2000 w. Concluded. Copper ores.

LEAD. Treatment of sulphite ores containing lead and zinc. P. A. MacKay, Canad. Pat. 223940. *Off. Rec.* (Sept. 19, 1922) **50**, 2662. 300 w. Treat with sulphur acid.

LITHIUM. Process for extracting lithium and potassium from lithium-potassium ores and also forming potassium alum from such ores. G. E. Bailey and A. E. Sedgwick, U. S. Pat. 1430877. *Off. Gas.* (Oct. 3, 1922) **303**, 75. 30 w. Heat with potassium sulfate not above 1500° F.

NICKEL. Recovery from its sulfide. H. W. C. Annable, Canad. Pat. 224406. *Off. Rec.* (Oct. 2, 1922) **50**, 2800. 290 w. Convert to sulfide, oxidise to sulfate and leach.

SILVER. Recovery of lead and silver from ores and metallurgical products. H. Hey, U. S. Pat. 1432858. *Off. Gas.* (Oct. 24, 1922) **303**, 653. 75 w. Also U. S. Pat. 1432859. **303**, 653. 55 w. Chloridize and leach.

TIN, Electrolysis. A. E. White, Brit. Pat. 183507. *Ill. Off. Jnl.* (Sept. 20, 1922) 3911. 100 w. Hydrofluosilicic acid and phenol or benzol are used.

TUNGSTEN. Method of treating tin-bearing tungsten ores. F. M. Becket, U. S. Pat. 1431559. *Off. Gas.* (Oct. 10, 1922) **303**, 266. 30 w. Roast and leach out tungsten with alkaline solution.

VANADIUM, Process of recovering. K. B. Thews, U. S. Pat. 1430864. *Off. Gas.* (Oct. 3, 1922) **303**, 73. 50 w. Precipitate with a calcium compound keeping the solution acid.

ZINC. Effect of single impurities on the electrodeposition of zinc from sulfate solutions. J. T. Ellsworth, Am. Electrochem. Soc. *Advance Copy* (Sept. 25, 1922) 187–202.

ZINC. Electrolytic zinc production. Om elektrolytisk sinkutvinning. W. Palmer, *Teknisk Tidskrift* (Sept. 23, 1922) **52**, 611–4. 2500 w. Serial.

ZINC. Electrolytic zinc works in Tasmania. *Engr.* London (Sept. 22, 1922) **134**, 289–90. 2000 w.

ZINC. Electrometallurgy of zinc. Electrolytic and electrothermal. L'électrométallurgie du zinc. I. Électrolytique. II. Électrothermique. M. Gojon and M. Lemarchands, *Chimie & Ind.* (Sept., 1922) **8**, 506–23

ZINC. Extraction of lead and zinc. W. G. Waring, U. S. Pat. 1430270. *Off. Gas.* (Sept. 26, 1922) **302**, 673. 75 w. Treat with ammonium carbonate.

ZINC, Extraction. W. G. Waring, U. S. Pat. 1430269. *Off. Gas.* (Sept. 26, 1922) **302**, 672. 55 w. Uses hot ammonium sulfate solution, then ammonium carbonate.

## Electro

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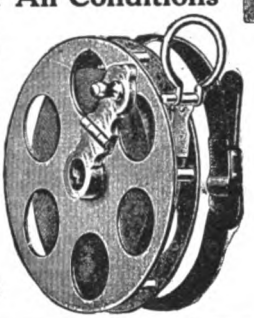

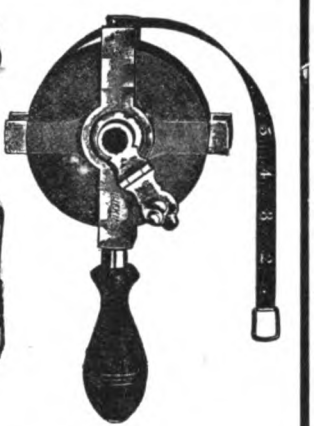

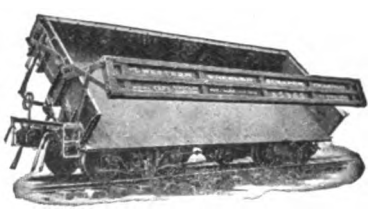

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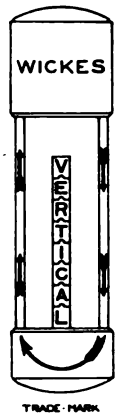


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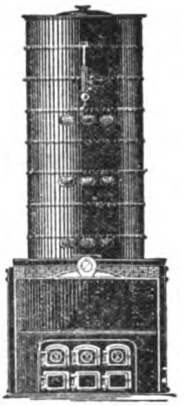

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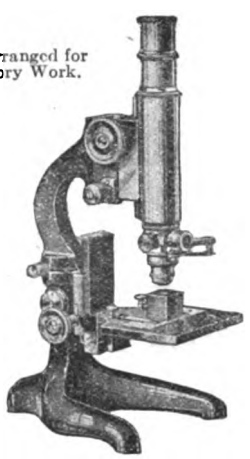

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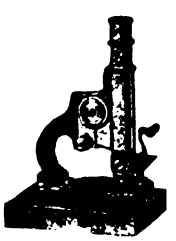

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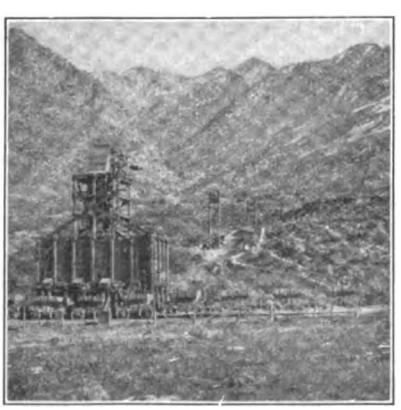

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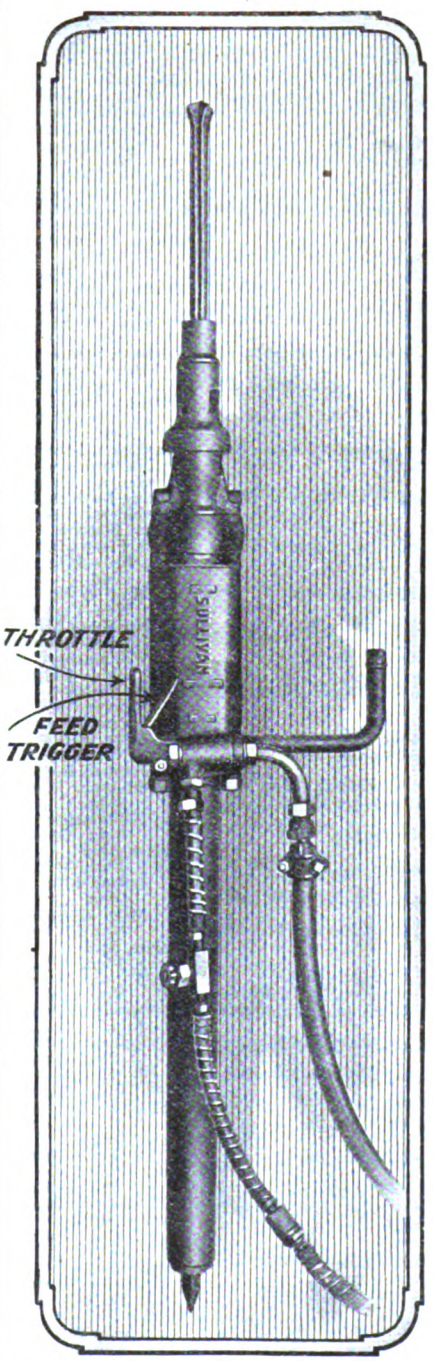


There is no leakage, and on vertical holes, the water from the holes fall within a 12-inch circle at the foot of the drill.

"DT-421" Stopers are top-notchers in footage, first because of the water-jet; second, because they are **self-rotating;** and third, because the one-hand feed trigger control enables the feed to be stopped instantly or regulated to any desired speed, depending on the ground conditions.

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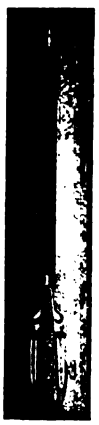

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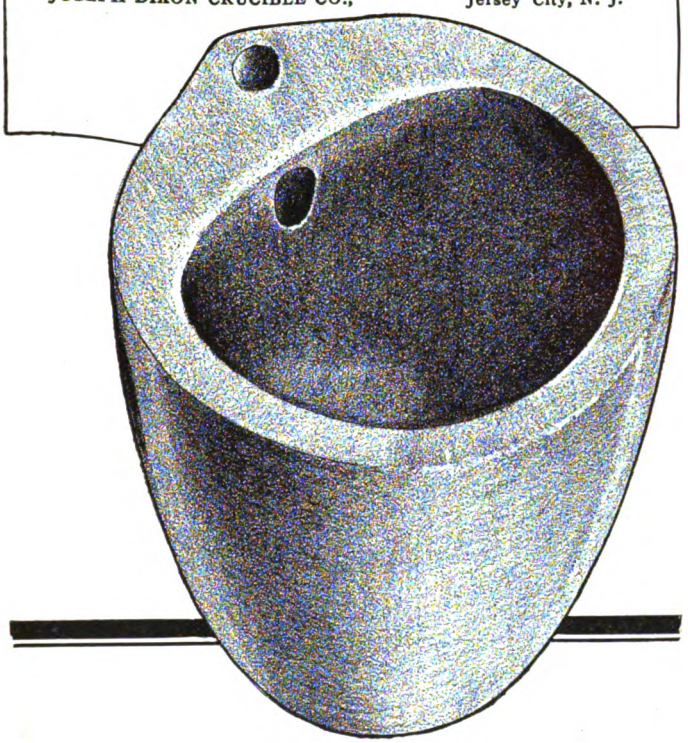

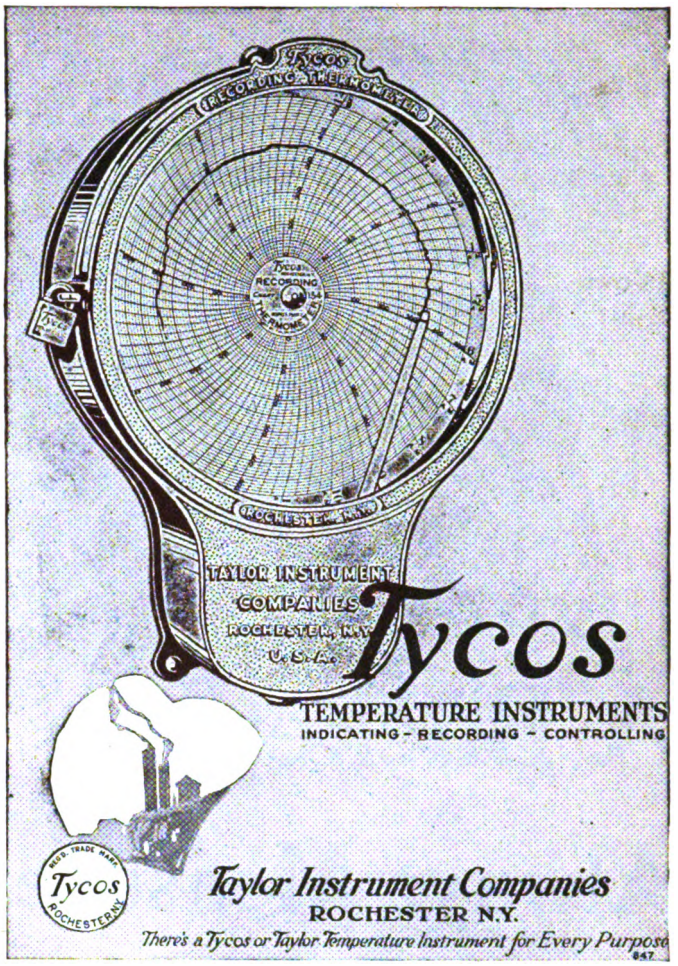


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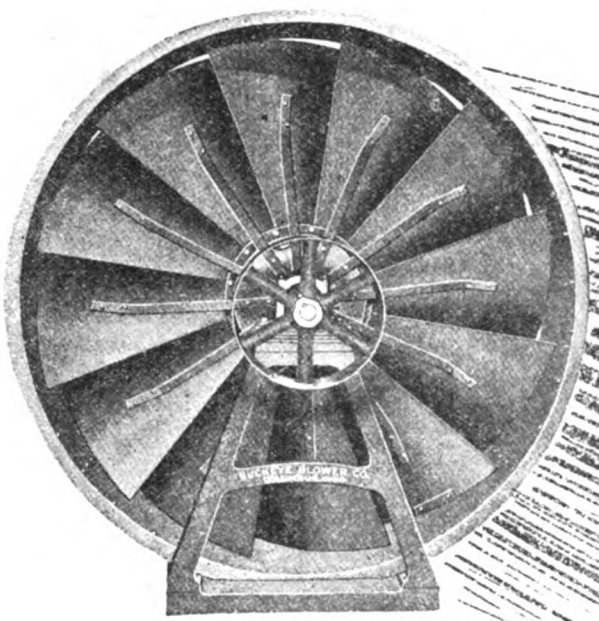

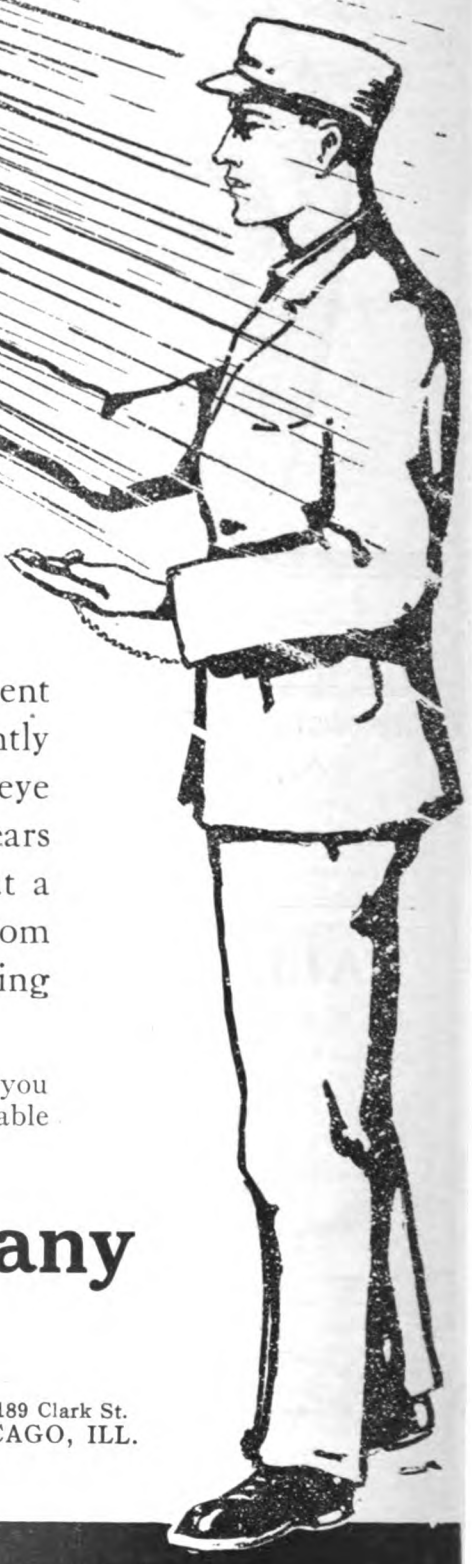

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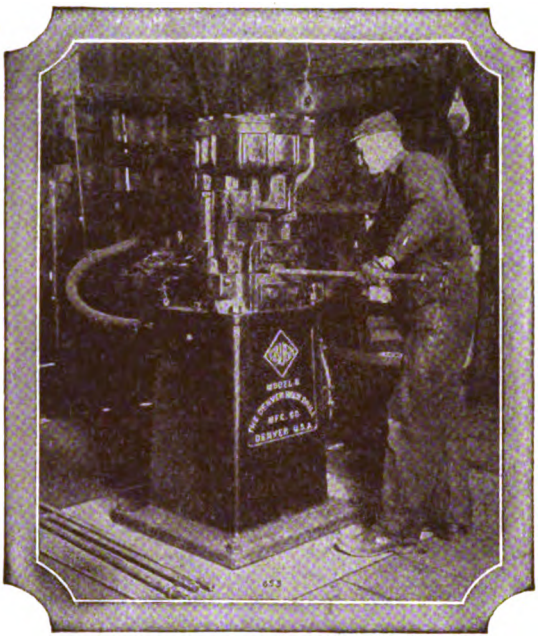

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